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# The Journal of Zoological Research

*Edited by*

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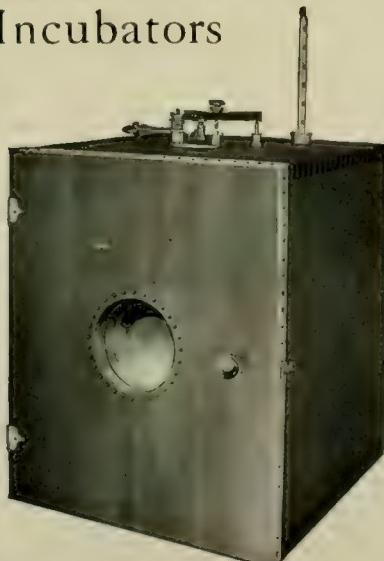
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# Another Record of a Small Whip Scorpion in California

M. L. MOLES

In April, 1916, Dr. W. A. Hilton collected some small whip-scorpions in the Pomona College Park at Claremont. These creatures were without eyes and yet they seemed to avoid forceps. They were able to run backwards or forwards with equal ease. On examination it was found that there were long hairs on the legs such as shown in the figure. Other specimens were afterwards found in one of the nearby canyons, and two specimens in the college collection were marked "C. Metz, in the mountains near Claremont."

Upon looking through the literature the species was determined to be *Trithyreus pentapeltis* Cook. In 1899 Dr. Hubbard collected some at Palm Springs under stones in the canyon near the stream. Those which we have found this year were under the dried oak leaves some distance from water. Cook gave the generic name *Hubbardia* which has not been sustained.

The following are the measurements of two types of the twenty or more specimens found.

## Measurements—supposed Male:

- Length of whole body, 7.5 mm.
- Length of cephalothorax, 2 mm.
- Length of abdomen, 3 mm.
- Length of tail, 2.5 mm.
- Length of first leg, 8 mm.
- Length of maxillæ, 1.5 mm.
- Width of abdomen, 1 mm.
- Width of cephalothorax, 8 mm.

## Measurements—Supposed Female and Juvenile, Fig. 1:

- Length of whole body, 4.5 mm.
- Length of cephalothorax, 1.5 mm.
- Length of abdomen, 2 mm.
- Length of tail, 1 mm.
- Length of first leg, 5.5 mm.
- Length of maxillæ, 2 mm.
- Width of cephalothorax, 6 mm.
- Width of abdomen, 1 mm.

*Color of supposed Male*—Cephalothorax and maxillæ, dark reddish brown. Abdomen and legs light yellow brown.

*Color of supposed Female and Juvenile*—All parts bright yellow brown.

Cephalothorax suboval, upper margin strongly concave at the sides and tapering to a point at the median line. Sides convex at upper edge; lower margin strongly convex. The cephalothorax is strongly chitinized, showing two small oval spots. The small suboval area between the chitinized cephalothorax and the abdomen is soft with five chitinized plates.

On the dorsal surface of each abdominal segment are two muscle depressions, while on the ventral surface the fourth, fifth and sixth segments have dark colored plates near the segmental divisions which are used for muscle attachments; besides the two muscle depressions.

The book-lungs openings are found on the ventral surface of the first abdominal segment, as is also the epigynum.

The caudal appendage of the juvenile and female is made up of three small joints tapering to a blunt end. It is held in an upright position above the abdomen. Cook in his description supposed this form to be a female or juvenile; Krayselin considers it a different species, but upon close study of the rest of the organs of this form it was finally decided that it was a juvenile and probably a female, the supposition being held that the juvenile took the form of the female, as is often the case, until the last few molts. The epigynum of this form was extremely undeveloped, having only a small epigastric furrow with depressions at either end.

The caudal appendage of the supposed male is made up of two stout joints to which is attached a heart-shaped body tapering to a blunt apex. This body has deep pits both on the dorsal and ventral sides near the base.

On the tibia of the first pair of legs are two long special sensory hairs set in little pits. On the second, third and fourth legs one hair was found, also on the tibia. These hairs are three-fourths as long as the leg.

The mouth parts consist of a pair of strong mandibles and labium. The labium is placed between the two coxae of the maxillæ.

The long process of the coxa clothed with its long simple hairs seems to have some performance in the work of the mouth parts. The labium is suboval, clothed thickly with simple short hairs, the upper margin having a single row of long heavy straight hairs with many long single curved hairs covering them.

The mandibles are provided with three distinct kinds of hairs or spines. The large subquadrate proximal joint was clothed with long barbed spines, the movable finger having on its median surface a row of fifteen back curved barbed spines. In the space between the movable and stationary finger were long hairs, enlarged in the center and tapering off to a fine point, the tapered portion being barbed. The mandibles are set well down in the sephalothorax.

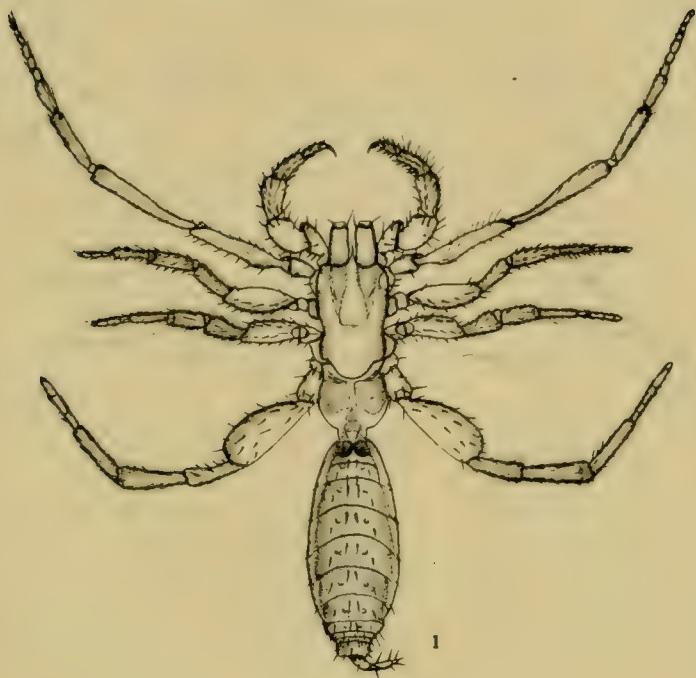
The sexual openings were found in the usual place; the ventral surface of the first abdominal segment, this being enlarged so as to do away with the second abdominal segment. The epigynum consists of a long epigastric furrow with a large lip-like opening near its median line. Just above this opening and on either side were small longitudinal creases.

Prof. Dr. Friedrich Dahl places the external sexual organs of this family on the legs and in the Thelyphonidæ which is closely related. They are found in the second joint of the tarsus of the first legs. Careful study failed to find any trace of secondary sexual organs in *Trithyreus pentapeltis*.

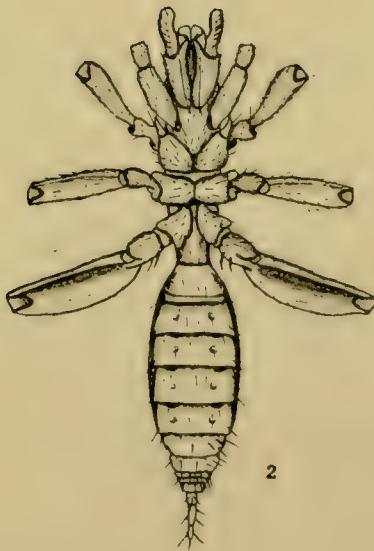
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<i>(Contribution from the Zoological Laboratory of Pomona College.)</i>	

## EXPLANATION OF FIGURES

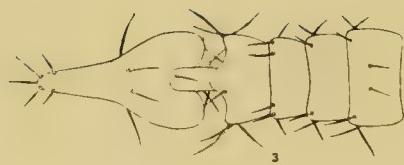
- Fig. 1. Drawing of the upper side of a young *Trithyereus pentapelti* Cook X10.
- Fig. 2. Lower or ventral view of *T. Pentapeltis* X10.
- Figs. 3, 4, and 5. Various views of the caudal end of an adult *T. Pentapeltia*.  
Much enlarged.
- Fig. 6. Labium. Much enlarged.
- Fig. 7. Maxilla. Much enlarged.
- Fig. 9. Mandible of *Trithyereus*. Much enlarged.
- Fig. 9. One jaw of mandible. Much enlarged.

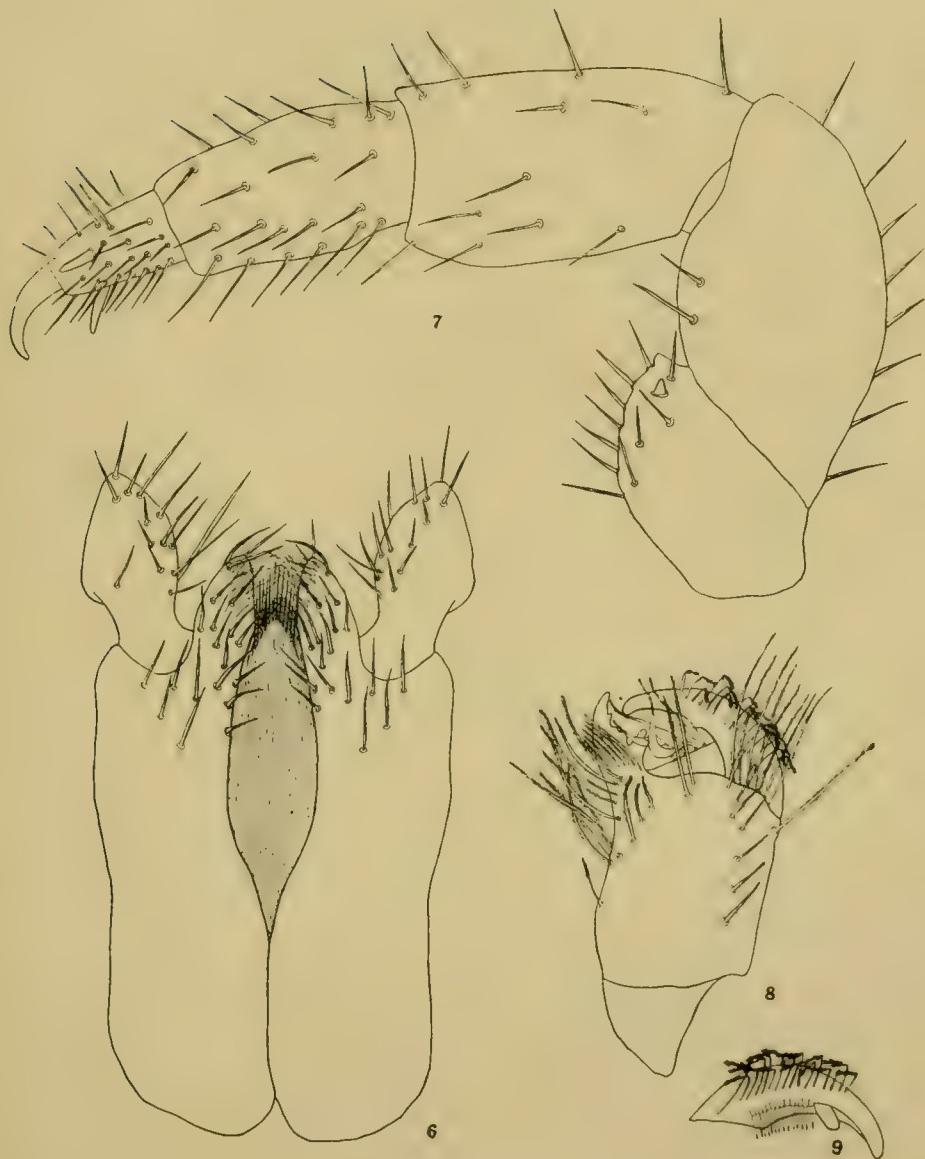


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# Notes on Chalcid Flies, Chiefly From California

A. A. GIRAULT

The following descriptions are chiefly from specimens sent by the Department of Zoology of Pomona College.

## *Eusandalum californicum* n. sp.

*Female:* Similar in every respect to *coquillettii* Ashmead except as follows: The hyaline cross-stripe between the fuscous cross-stripes of the forewing is distinctly narrower than either fuscous cross-stripe (broader than either in the other); the stylus of the abdomen is a little shorter than the ovipositor valves (their extruded portion), both equal in length in *coquillettii*. Otherwise the same. Antennæ 11-jointed, tapering, the club single and no longer than the pedicel, funicle 1 quadrate, 2 longest, elongate, somewhat compressed, over thrice the length of the pedicel. Types compared.

A female from Claremont (C. F. Baker).

*Types:* Catalogue No. 20357, U. S. National Museum, the female on a tag, a fore wing antenna and hind leg on a slide.

In the U. S. National Museum a female from the Santa Cruz Mountains, California, part of the type of *coquillettii* (now a single female from Los Angeles).

## *Eusandalum obscurum* n. sp.

The type is one female from Easton, Washington (Kincaid). Catalogue No. 20358, U. S. National Museum, the female on a tag. See table.

## *Eusandalum alpinum* n. sp.

The type is a part of the type of *coquillettii* from the Santa Cruz Mountains, California; Catalogue No. 20359, U. S. National Museum, the specimen on a tag. See table.

## *Eusandalum georgia* n. sp.

One female, pinned, Georgia, Catalogue No. 20369, U. S. National Museum. A second female from Washington, D. C. See table.

*Eusandalum arizona* n. sp.

A female, Santa Rita Mountains, Arizona (Schwarz), May 27. Catalogue No. 20361, U. S. National Museum, tag. See table.

Synopsis of the North American Species of *Eusandalum*. Females. (From the types.)

1. Wings bifasciate, the distal fuscous band at apex. Legs red except the coxae, the antennae wholly concolorous. Ovipositor extruded for over half the length of the abdomen. Scutellum longitudinally lined.

Hyaline band of fore wing distinctly narrower than either fuscous band (one on each side of it); stylus a little shorter than the ovipositor. *californicum* Girault

Hyaline band of fore wing somewhat broader than either fuscous stripe; stylus and ovipositor equal.

*coquillettii* Ashmead

2. Wings unifasciate or wholly embrowned or with a large unbroken, fuscous area. Wings wholly infuscated. Scutellum densely punctate like the scutum (in the first species). Propodeum with a lateral sulcus.

Ovipositor much extruded.

Legs reddish except the coxae and the first and third femora *ventrad*; more slender than usual, the ovipositor about as in *californicum* but the abdomen is longer, hence the ovipositor is so. Fore wing with a longitudinal white streak caudad of middle. *acmaeoderae* Rohwer

Ovipositor extruded for less than a fourth the length of the abdomen, the stylus subobsolete.

Fore wings indefinitely slightly stained; legs reddish except the coxae; scutellum long-lineolated. *obscurum* Girault

Wings infuscated from the bend of the submarginal vein to apex or nearly. Antennae concolorous (compare *obscurum*).

As in *californicum* but the scutellum finely punctate; differs from *acmaeoderae* in being more robust, the first and third femora are not metallic ventrad, the costal cell is broader, the tip of the fore wing is hyaline for a short distance.

*alpinum* Girault

Legs wholly concolorous except the knees and tips of tibiae narrowly and the tarsi; as in the preceding but stylus and ovipositor subequal. *cyaneum* Ashmead

3. Wings hyaline or subhyaline. Antennæ concolorous except at extreme base.

Ovipositor extruded for about half the length of the abdomen, the stylus slightly short.

Middle legs except coxae, all knees narrowly, tips of tibiae and the tarsi reddish brown. Postmarginal vein subequal to the stigmal. *hubbardii* Ashmead

Ovipositor extruded for less (or not more) than a third the length of the abdomen, the stylus subequal.

Postmarginal vein subequal to the stigmal.

Legs reddish except the coxae and cephalic femora and tibiae. Scutellum somewhat more distinctly lineolated longitudinally, punctate. Ovipositor short. *hyalinipenne* Ashmead

Postmarginal vein distinctly longer than the stigmal.

Legs concolorous except knees, tips of tibiae and the tarsi. Stylus somewhat shorter than the ovipositor which is a third the length of the abdomen. *georgia* Girault

4. Wings subhyaline. Antennae with the basal fourth of the scape honey yellow.

Postmarginal vein distinctly much longer than the stigmal, twice longer.

Ovipositor extruded for nearly half the length of the abdomen, the stylus a little shorter. Legs honey yellow except fore and hind coxae. *arizona* Girault

All the species have the postmarginal vein shorter than the stigmal or no longer, save where noted; the parapsidal furrows are distinct, but very short, joining before the middle of the scutum from cephalad. The club is usually single, the antennæ 11-jointed, tapering-filiform.

*Dialinus begini* Crawford

One female, Santa Clara County (C. F. Baker).

*Elachistus coxalis* Howard

One pair, San Mateo County, California, the male; and Laguna Beach, Southern California, the female (C. F. Baker).

The following species is an *Eudecatoma* (there being no distinct substigmal spot but only a very minute one) but for the present I include this segregate within the older one.

*Decatoma subimmaculata* n. sp.

*Female:* Length, 2.00 mm. Of the usual habitus and sculpture, the punctuation not coarse.

Honey yellow, the wings hyaline, the following black markings: Ocellar dots obscurely, upper margin of occiput (a crescent), median channel nearly to apex and cephalic margin of the propodeum (except laterad); abdominal petiole and the median line of abdomen dorsad narrowly, from just before apex of segment 2 nearly to the apex of segment 4. Abdomen compressed, segments 2, 4 and 5 subequal, longest, the abdomen glabrous, its petiole about twice longer than wide. Propodeum openly rugoso-punctate, the median channel single, distinct, no median basin. Pedicel black above, nearly twice longer than wide, a little longer than funicle 1, the other four funicle joints subequal, subquadrate. Club 2-jointed, the first joint shortest.

One female, Claremont, California (C. F. Baker); on oak.

*Type:* Catalogue No. 20400, U. S. National Museum, the female on a tag, the antennae and a caudal leg on a slide.

Differs from *catesbeiae* Ashmead (types compared), in being larger, the median channel of the propodeum is distinct for its whole length and does not consist principally of two large foreae, the cross-carina passing *profimad* of it has an area on each side of the meson which runs at first nearly parallel to the channel (the forking) but in the Florida species, this carina continues more or less parallel with the cephalic margin of the propodeum.

*Scutellista cyanea* Mots

One female, Claremont, California (C. F. Baker).

*Cleonymus californicus* n. sp.

*Female:* Length, 4.00 mm.

Dark metallic green, the tegulae, antennae (except the club and pedicel) and the legs (except the concolorous coxae, the apex of caudal femar lateral and the last two pairs of tibiae dorsad more or less), reddish brown, the venation fuscous, the fore wings bifasciate, the first stripe from the base of the marginal vein and broken distad of the middle, the second from the postmarginal vein, obovate in shape, twice the width of the first. The (triangular) head, the thorax and abdomen, scaly punctate, the propodeum and abdomen 2 subglabrous, the distal margins of the abdominal segments glabrous. Propodeum foreolate along the cephalic and caudal margins, and along the median carina on each side, the lateral carina represented by a distinct, curved, foreate sulcus, the spiracle large, subreniform. Scutellum simple. Antannae inserted near the clypeus, a little below the eyes, 11-jointed, the club pointed ovate, acuminate at apex, embraced by the long projection from one side of the apex of the distal funicle joint which reaches to distal three-fourths of the club. Funicles 1 and 2 narrowest, grading into 3, all subquadrate, 4 longest, a little longer than wide and subequal to the pedicel; 8 wider than long. Postmarginal vein a little longer than the slender, curved stigmal, about a third the length of the marginal. Stigmal vein parallel, in general trend, with the costal margin.

Two females, mountains near Claremont (C. F. Baker).

*Types:* Catalogue No. 20348, U. S. National Museum, the females on tags, a fore wing and an antennae on a slide.

The abdomen is subpetiolate; it was distinctly, quadrately petiolate in a male specimen of *cleonus depressus* in the U. S. National Museum.

*Entedon occidentalis* Girault

Several specimens, Claremont, California (C. F. Baker).

*Isosoma grande* Riley

One winged female, mountains near Claremont, California (C. F. Baker).

*Metapleura spectabilis* Westwood

One female, Claremont, California (C. F. Baker).

# The Rose Flea-Beetle

(*Haltica probata* Fall)

G. F. MOZNETTE,

ASSISTANT ENTOMOLOGIST, OREGON AGRICULTURAL COLLEGE,  
CORVALLIS, OREGON

## INTRODUCTION

From a careful perusal of the literature it is apparent that scarcely anything but the original description of *Haltica probata* Fall appears in print. As this species has at various times been reported on several of our cultivated plants, and as there is some possibility of its becoming destructive to our cultivated roses, observations have been made from time to time and this paper brings together, so far as possible, the recorded facts concerning the species.

## HISTORY AND DISTRIBUTION OF THE SPECIES

The species was first described by Dr. H. C. Fall in 1910.\* Mr. Arthur Gibson† mentions it as attacking leaves of strawberry plants at Nelson, British Columbia. The species is referred to as *Haltica evicta* Lec., but after a comparison with specimens in the writer's collection and later in Dr. Fall's collection at Pasadena, California, I am led to believe that the species reported by Mr. Gibson as *evicta* is not *evicta* but *probata*. It has been reported from Spokane, Washington, on strawberries, and at various times has been reported feeding on cultivated crops in Oregon.

The species is distributed along the Pacific Coast from British Columbia to California. It has been reported from Nelson in British Columbia; Everett and Spokane in Washington; from Corvallis, Pamelia Lake, Mary's Peak, the Three Sisters, and Josephine County in Oregon; and from Santa Rosa, Belmont, Siskiyou, and Trinity Counties in California.

## SEASONAL LIFE-HISTORY AND HABITS OF THE SPECIES

With the approach of warm weather in the spring, when the buds of the wild rose are showing their green, the little bronze

\*Transactions of the American Entomological Society of America, Vol. 36, pp.

†Canadian Entomological Circular No. 2.  
152-159.

beetles (Pl. I, Fig. 2) come from their winter quarters, about the middle of April or earlier depending on the spring weather conditions, and commence feeding on the tender small leaves of the expanding buds. The beetles possess a very brilliant lustre and when approached manifest a saltatorial habit, and may leap for a considerable distance. The insect passes the winter in the adult stage and during that time may be found concealed in convenient places. The writer has taken numerous individuals from beneath the moss of the scrub oak, which grows abundantly along the creeks in the Willamette Valley in Oregon. The first individuals were taken on April 11, 1913, feeding on a species of wild rose, *Rosa nukatana* Presl. near Corvallis, Oregon. The adults were at the time resting in the sun on the dried fruits of the rose and also on the moss which covered the oaks. In 1915, the first beetles were out on March 19 or somewhat earlier. Sometimes the March weather is too severe so that the beetles do not appear until later, and the inclement weather frequently puts a stop to the activity of the beetles and retards oviposition.

After emerging from their hibernating quarters, the beetles jump or fly to the nearest rose bush and soon begin to satisfy their appetite after the long winter's fast. At this time the tender bursting rose buds seem to be the favorite food, and the beetles engorge themselves with bites from the prospective crop of leaves, then locked up in the buds. The beetles seem to be most active during the warmer sunny portions of the day, when they may be seen jumping and flying about the rose bushes. When touched or jarred, they at once drop quickly to the ground, where they feign death for a short time, later returning to the foliage. Their shining bronze color renders it easy to discover and watch them at their destructive work. They begin gnawing an unsightly hole into either the side or top of the bursting leaf bud, often boring into the bud so far as to be almost hidden from view. It usually takes the beetles a few days to satisfy their vigorous spring appetites; then they turn their attention to the propagation of their kind. The later emerging adults feed voraciously on the foliage (Pl. I, Fig. 5) eating out irregular places in the leaves.

Many individuals were found in copulo on April 12, 1913, and on April 14, 1915. Eggs were laid in great numbers April 15, 1913, but not until the first of May in 1915, due to a long stretch of cold wet weather. By May 18 many eggs were to be found but usually no larvae. The eggs are laid in masses (Pl. I, Fig. 3) of from two to fifteen in a cluster with an average of between seven and nine. They are deposited usually on the lower surface of the leaf. No eggs are deposited until the foliage is well along usually, as this is the food of the larvae. The writer observed a female during oviposition. She thrusts out the egg and by a mucilagenous substance causes the egg to adhere fast to the leaf. She decorates the egg, as it were, with a fluid which later turns black and appears as a streak across the ova. The adults do not live long after egg deposition, usually about a week and a half. A number of females were observed to lay from forty to fifty eggs each.

The length of the egg stage was found to vary considerably even in the insectary, due no doubt largely to the weather conditions. In indoor observations it ranged from seven to fifteen days, with an average of twelve. In the open, eggs under screen cloth were deposited on May 24, 1913, and hatched June 10, 1913, a duration of seventeen days. By June, 1913, practically all of the egg masses had hatched and scarcely an adult could be found anywhere. The larvae are at first yellow, changing over to a black after a short period of time (Pl. I, Fig. 7). The eggs split at the side when the young emerge and the larvae remain quiet for some time apparently feeding first on the remaining egg juices. After a while they begin to move about for convenient feeding spots. The larvae moult three times, and after each moulting appear yellow, soon changing to a black. Several of the grubs usually work on the same leaf, continuing to eat small irregular holes, through, or nearly through, the leaf until it appears skeletonized (Pl. I, Fig. 7), when they seek new pastures.

When full grown the larvae drop to the soil and after burrowing to a depth of about an inch or less, they construct soil cells of earth (Pl. I, Fig. 6), not unlike the cell of the common cherry and pear slug, in which they pupate. By July 3, 1913, many larvae were

falling to the soil. The length of the larval stage varies from fifteen to twenty-five days with an average of twenty days. By July 10 many pupae (Pl. I, Fig. 4) were found in the soil. The writer neglected to ascertain the exact length of the pupal stage, but from the meager observations made up to this time ventures the opinion that it is about eighteen days. By the first of August many adults could be found. They are a beautiful metallic color when just emerged. The writer bred from the adults a species of Diptera a *Tachinid* but has not been able to ascertain the species. Subsequent observation revealed no eggs, so undoubtedly the species is single brooded. The life-cycle is calculated to last about fifty-five days from eggs to adults, but this is greatly influenced by the weather conditions. The length of the adult stage is about ten months, depending, of course, upon the time the warm days approach in the spring and upon the cold stretches which intervene, conditions which influence emergence from their hibernating quarters.

#### DESCRIPTION OF THE VARIOUS STAGES

The Eggs (Pl. I, Fig. 3) are of an orange color, oblong oval or bean-shaped. The egg has a delicate covering by which it is attached to the leaf. Nearly every egg has a sort of spine-shape structure attached, although it is not exactly a spine but a part of the egg covering, which, when it has dried, gives it a black streaked appearance at that point. The egg measures 1 mm. in length by .25 mm. in width.

The Larvae (Pl. I, Fig. 7) when full grown have the body wider at the anterior end, tapering gradually to the anal segment and covered with many hairs. They are covered with an oily substance in which they often collect their excrement as they feed and travel. The entire larva is black and the segments of the body possess numerous tubercles bearing setae. Each segment of the abdomen has a group of tubercles on a side above the spiracles. When full grown the larvae measure from 6 to 8 mm. in length.

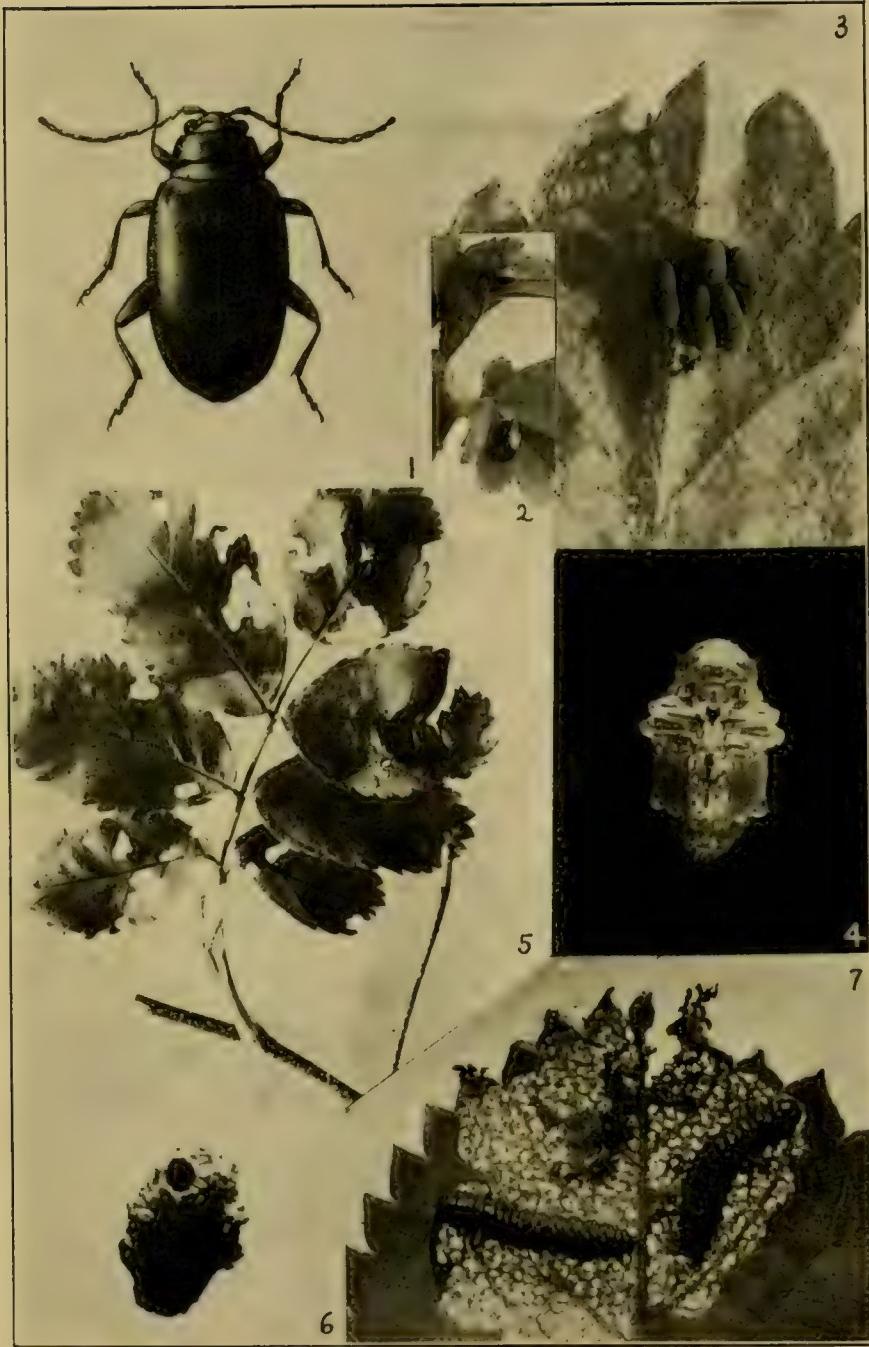
The Pupa (Pl. I, Fig. 4) is yellow, 4 to 6 mm. in length, with the wing pads and legs of a paler yellow to nearly white. Two setae are located on the vertex and two on the occiput of head. The

prothorax, mesothorax, and metathorax bear spines varying in number. The abdomen possesses three rows of setae on each side above the spiracles.

The Adult (Pl. I, Fig. 1) is green bronze, entire upper surface polished and strongly shining sculpture throughout, nearly as in *Haltica ignita*. Antennae piceous, slightly more than half the length of the body, joints 2-3-4 gradually increasing in length, the fourth very nearly three times as long as wide. Eyes rather small and not very prominent, their width as seen from the front distinctly less than half the interocular distance. Prothorax two-thirds wider than long, sides parallel in basal half, convergent anteriorly. Elytra fully two-thirds as wide as long, and nearly three-fourths wider than the prothorax. Body beneath piceous; abdomen alutaceous, rather coarsely punctate and transversely rugulose. Length 3.7 mm. to 4 mm.

#### EXPLANATION OF PLATE

- Figure 1. The adult beetle (greatly enlarged).
- Figure 2. The adult beetle (natural size).
- Figure 3. Eggs in situ on leaf greatly enlarged.
- Figure 4. Pupa greatly enlarged.
- Figure 5. Rose leaves showing work of adult beetles.
- Figure 6. Pupal soil cell.
- Figure 7. Larvæ at work skeletonizing leaf.



# Notes on Birds of Laguna Beach and Vicinity for 1916

H. H. NININGER

In addition to the work done by Mr. Leon Gardener and others on the distribution of birds in the vicinity of Laguna Beach I noted the following species in the summer of 1916:

## 70. *Sturna hirundo* (Common Tern)

This species was found occasionally about the muddy flats at Balboa.

## 74. *Sturna antillarum* (Least Tern)

The Least Tern is much more common than the former. They were often seen in small flocks diving for fish along the coast from Laguna to Balboa. They probably nest along the sandy shores; but none of their nests were taken by the writer.

## 95. *Puffinus griseus* (Dark Bodied Shearwater)

These birds were found ten to twelve miles from shore, in flocks feeding over schools of fish. They are called by the fishermen "Barracuda Birds."

## 210. *Rollus obsoletus* (Calif. Clapper Rail)

Found in the swampy tracts about Balboa.

## 214. *Porzana carolina* (Sora Rail)

A specimen of this Rail was taken at one of the lakes in Laguna Canyon in the latter part of July.

## 421. *Chordeiles acutipennis* (Texas Night Hawk)

Either at dusk or at dawn these birds could be found abundantly, in certain localities, feeding over fields, pools and streams to which they came at dusk, from the hills where they spent the daylight hours. Mr. C. C. White found a pair of young almost ready for flight on one of the hills bordering on Laguna Canyon, July 7, 1916.

## 425. *Aeronautus melanoleucus* (White-throated Swift)

Mr. Charles A. Keeler in "Bird Notes Afield" (1889) records this species from Capistrano. To one accustomed to meeting with

this bird only among the high and almost inaccessible cliffs of the mountains it is no little surprise to find it in a district so nearly level as the region about this old mission settlement. But surely it is there. A visit to the place in the latter part of July revealed the fact that they are, seventeen years since Mr. Keeler's writings, still using the same broken walls as a retreat. I think they are nesting at the time we visited the place, for upon the entrance of an adult into one of the crevices there came cries of young birds which seemed to be coming from birds that were being fed.

530a. *Astragalinus P. hesperophilus* (Green-backed Goldfinch)

Common around Laguna and the neighboring hills. Nests with eggs were found, probably the second brood for the season.

634. *Vireo vicinior* (Gray Vireo)

Found along the streams near Capistrano.

685a. *Wilsonia pusilla pileolata* (Pileolated Warbler)

Fairly common in trees along streams near Capistrano.

364. *Pandion haliaetus carolinensis* (American Osprey)

One of these magnificent birds was found on the rocky cliffs bordering the shore between Laguna and Balboa. It was seen several times and was reasonably tame.

### BREEDING NOTES

In addition to the nests of the more common birds the following were noted:

Several Raven nests on the cliffs bordering the shore and are in Boat Canyon about a mile from the sea were found deserted, but feathers of their owners and the remains of their food betrayed their identity.

A brood of Ruddy Ducks was seen on one of the lakes in Laguna Canyon several times.

Coots were found breeding about the lakes in abundance.

(*Contribution from the Zoological Laboratory of Pomona College*)

# Solpugids From the Claremont-Laguna Region

J. NISBET

The following list of solpugids represents a collection obtained by students and others during the past four or five years. Drawings are given of one large specimen and top and side views of the head region of several others. The determinations are by Dr. N. Banks.

## *Eremobates formicaria* Koch

This species has been taken from our region although such large specimens have been reported only from dryer regions. This specimen, a male is from Brawley, Cal. (Figs. 1 and 2). Figs. 3 and 4 were taken from a young specimen collected at Claremont.

The movable finger of the chelicerae of the male has two large teeth. Anterior margin of rephalothorix straight. Hind tarsi one segment.

## *Eremobates californica* Sim.

The drawing are from a specimen taken at Laguna Beach (Figs. 5 and 6). Specimens were also taken at Claremont. Movable finger of the chelicerae with a large tooth. This is not so marked in the female. Hind tarsi one segment.

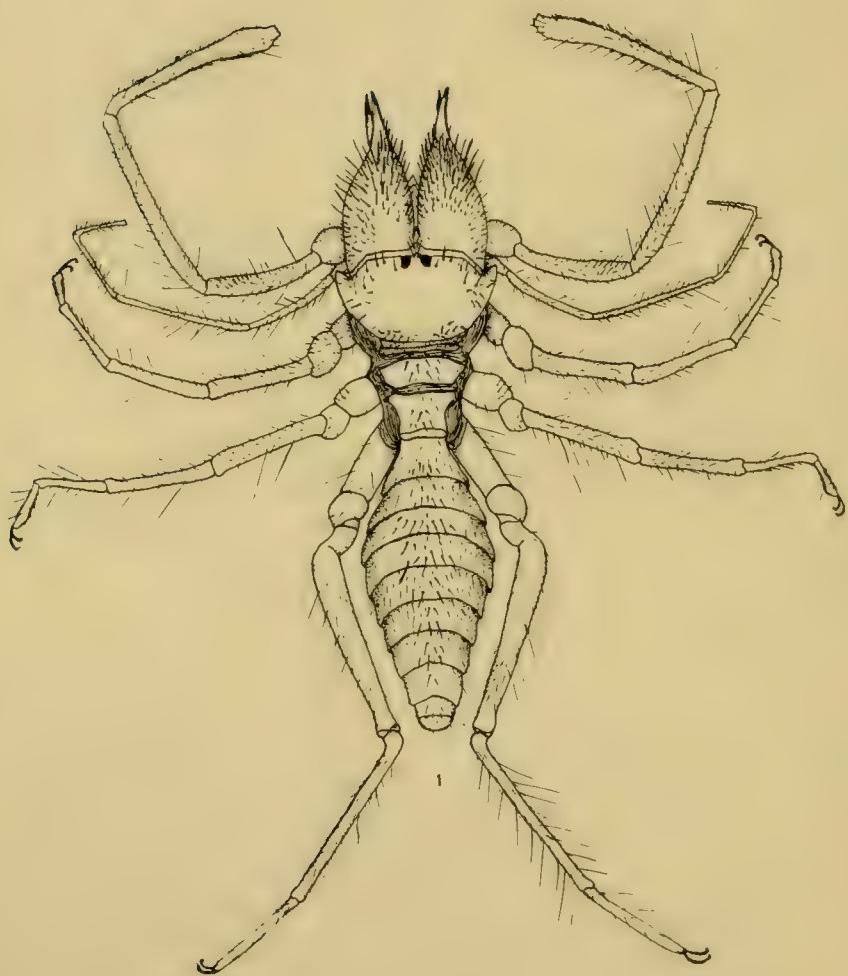
## *Hemerotrecha californica* Banks

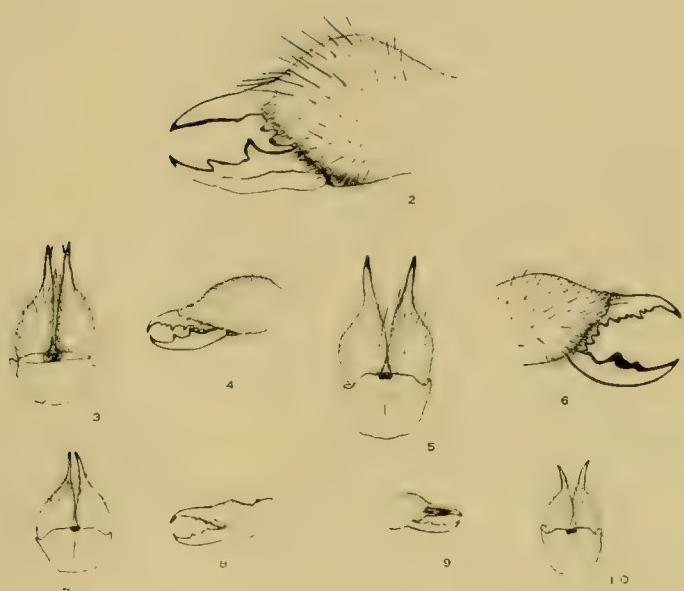
Specimens were obtained at Claremont. Upper finger of chelicerae without teeth or many small teeth. Male has an elongated flayellow of two parts on the upper finger of chelicera. Hind tarsi with three joints. Specimens obtained were about evenly divided between this and the previous species (Figs. 7, 8, 9 and 10).

(Contribution from the Zoological Laboratory of Pomona College)

#### EXPLANATION OF FIGURES

- Figure 1. *Eremobates formicaria* Koch. X2.
- Figure 2. *Eremobates formicaria* Koch, side view of chelicera. X2.
- Figures 3-4. Chelicerae from young *E. formicaria*. X2.
- Figures 5-6. Chelicerae from *E. californica* Sim. X2.
- Figures 7-8. Chelicerae from *Hemerotrecha californica* Banks, views of the chelicerae. X2.
- Figures 9-10. *H. californica* views of chelicerae, another specimen. X2.





# Record of Two Pseudoscorpions From Claremont-Laguna Region

WINIFRED T. MOORE

## *Garypus Californicus* Banks

Description: Fig. 1. Length 5 mm.,

Color: Cephalothorax and pedipalps dark brown, abdomen and legs light yellow; each abdominal scutae with a dark central spot; anterior ventral scutae also with dark spots. Cephalothorax emarginate; four eyes; femur of pedipalps longer than cephalothorax, tibia hardly convex on inner side, hand about as long as tibia, fingers longer than hand; legs long and slender.

Habitat: Specimen found under rocks near ocean at Laguna Beach, collected by Walter Sturgis.

## *Chelanops pallipes* Banks

Description: Fig. 2. Length 2 mm. including mandibles.

Color: Cephalothorax light reddish brown, pedipalps darker, abdomen and legs pale yellow.

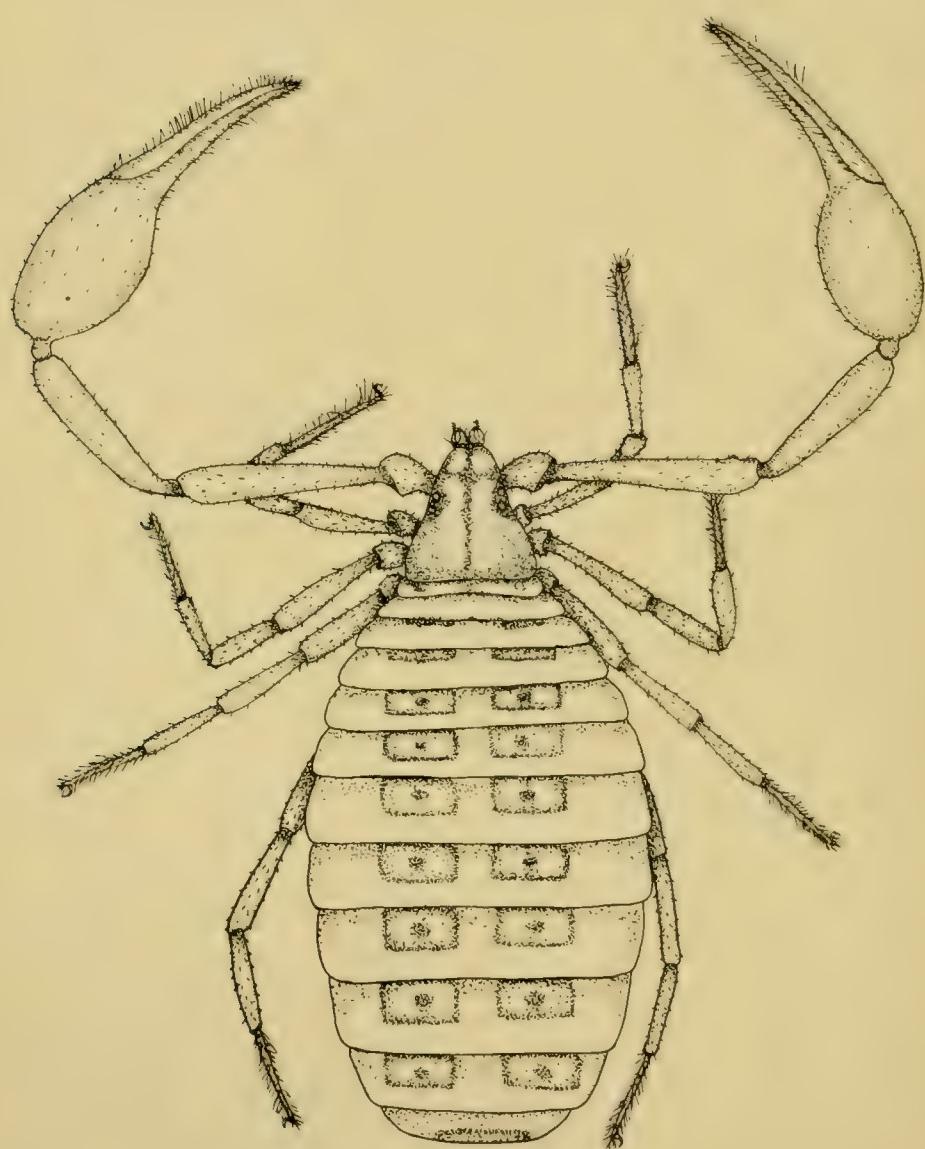
Similar to *C. dorsalis*, but fingers a little longer than hand; no eye spots, clavate hairs found on all parts of two types, on legs and pedipalps more clavate on one side (Fig. 3) on body evening clavate (Fig. 4). Simple hairs found on under surface of tarsus. All parts covered with small chiton plates.

Habitat: Specimens taken from under stones in wash near Claremont.

(Contribution from the Zoological Laboratory of Pomona College)

EXPLANATION OF FIGURES

- Figure 1. *Garypus Californicus.* X20.  
Figure 2. *Chelanops pallipes.* X20.  
Figure 3. Hair from legs and pedipalps of *C. pallipes* much enlarged.  
Figure 4. Hair from body of *C. pallipes* much enlarged.





# The Central Nervous System of a Sipunculid

WILLIAM A. HILTON

A number of specimens of the genus *Phascolosoma* were obtained at Laguna Beach. These were preserved in various fluids. Flemming's fluid and mercuric chloride, were especially valuable for study. The nerve cords were dissected out and mounted after staining. Some were imbedded, sectioned and stained. The stain which brought out the cells with greatest clearness was copper haematoxylin.

The general character of the nervous system of sipunculids is well known, and the specimens examined at this time were typical as to the form of the brain and cord. The brain is imbedded in the proboscis just below the tentacles. It has a similar appearance in section to the photographs of Spengel, 1912. The brain is small. Two main branches supply nearby tentacles and muscles. There is a pair of small branches from the connectives. Extending from the epithelium of the tentacular region is a pair of tubes leading into the brain, the cerebral organs. These epithelial tubes lead to a pigmented area on each side, and these pigmented areas in section look like simple eyes. A few irregular spots of pigment were found near the larger masses. The epithelium at the outer end of the tube was also deeply pigmented.

Throughout the body the ventral nerve cord kept about the same width, although the muscle bands at the sides increased somewhat. The strands connecting the muscles and nerves to the animal's body were more or less regularly arranged. In specimens with the proboscis drawn in, the nerve cord is of course doubled back on itself. In the specimen drawn at the junction of the two parts, that of the proboscis and that of the ventral body-wall, there is a lack of lateral branches, as shown in the upper portion of the second line of the drawing. Towards the caudal end the lateral branches come off more irregularly.

When the animal is contracted the nerve cord seems to be segmented, but sections show that this appearance is due to the slight

folding of the nerve cord within the muscle bands; the nerve tissue does not seem to be elastic.

Very little has been written on the histological structure of sipunculids. Haller, 1889, discusses a number of points, especially in *sipunculus nudus*, relating to the ventral cord only. I find a number of differences in this form. I did not find any very clear evidence of special neuroglia cells, such as described and figured by Haller, such elements may be present, but at least they are not evident, not so evident as in many other invertebrates which I have examined. Nerve cells may anastomose with each other as shown in Haller's figure, but of this I can not be sure. If fibres do not unite they are in very intimate contact.

In the ventral cord no small fibrils were seen only rather small fibers which may have been fibrils. The lack of connective material in part at least, perhaps because the nervous system is often extended and folded, shows the cell processes with great distinctness. This may be why a clearer picture than usual is presented of the relationship of cells.

Cells are abundant on the ventral side of the cord, especially in the middle line. The more dorsal fibrous region is practically without cells of any kind. No very marked tracts of fibers are evident, the fibers are about equally distributed in all directions and may be subdivided as follows:

1. Fibers which enter the fibrous mass from cells and run short distances up and down.
2. Fibers which pass from cells to other cells near by in the cellular area.
3. Fibers which leave the ganglion laterally from ventral cells.
4. Fibers which enter from the lateral nerves to end in the fiber area or in among the cells.

There are no indications of long fibers, either ascending or descending. After the examination of the cord of this animal one is impressed with the suggestion that many cells of similar sort act alike, that is groups of cells, not individuals are involved in the simplest transmissions of impulses. This general suggestion which, of course, is not new, comes to mind with great clearness after the

study of thin sections of the cord of this animal. Whether the cells actually anastomose or not is a question hard to decide, but in the numerous contacts of naked fibers there is, I believe, ample opportunity for the transmission of complex changes from cell to cell, to all parts of the nervous system. In this form there is no particular localization of definite centers.

The brain differs in structure from the cord, the central fibrous mass is more dense, the cells are very much smaller and more numerous. Some cells of the brain send their fibers out directly without the common pathway of a distinct nerve trunk. No special features of the brain were determined except the cerebral organs already described.

<i>Andreae</i>	1882
Beitrag zur Anatomie und Histologie des <i>Sipunculus nudus</i> . Zeit. f. Wiss. Zool. t. xxxvi.	
<i>Andrews, E. A.</i>	1887
Notes on the anatomy of <i>Sipunculus gouldii</i> Pourt. Studies Biol. Lab. J. H. univ. vol. iv.	
<i>Delage et Herouard</i>	1897
Traite de zoologique concrete. Les vermidiens. vol. v. Paris.	
<i>Haller, B.</i>	1889
Beitrage zur Kenntniss der Textur des Central nervensystem Hoherer Wurmer. Arb. des Zoolog. Inst. Wien Tom. viii. Heft 2.	
<i>Marcel, A. Herubel</i>	1907
Recherches sur <i>Sipunculides</i> . Chap. iv. Le system nerveux. Mem. soc. d. France. t. xx.	
<i>Melalnikoff, S.</i>	1900
Zeit. Wiss. Zool. Bd. Ixviii.	
<i>Herubel, A.</i>	1902
Sur le cerveau du Phascolosome. Ac. d. Paris. cxxiv.	
<i>Spengel, J. W.</i>	1912
Beitrage zur Kenntnis der Gephyren. Zeit. Wiss. Zool. Bd. xxxiv.	
<i>Ward, H. B.</i>	1891
Some points on the anatomy and history of <i>Sipunculus nudus</i> . Bull. Mus. Comp. Zool. Harvard College.	

(Contribution from the Zoological Laboratory of Pomona College)

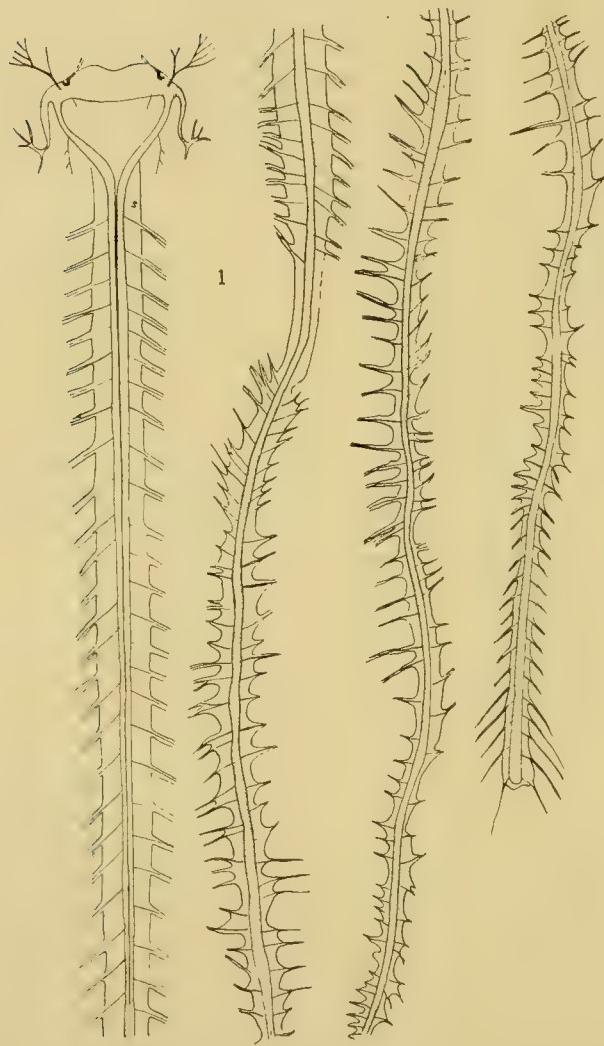
#### EXPLANATION OF FIGURES

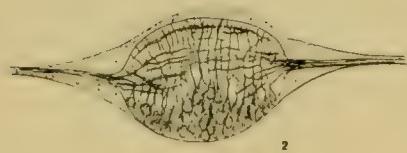
Figure 1. Central nervous system of *Phascolosoma* X15. The cord is shown in three separate pieces. The lower end of the first or left-hand drawing should join with the second and so on. The central nerve band is shown with the lateral branches of muscle and nerve. The brain is shown attached to the first segment at the left. The pigment spots, cerebral tubes and chief nerves are shown. The brain is drawn from reconstructions made from serial sections.

Figure 2. Cross section of the nerve cord. X75.

Figure 3. Longitudinal section of the nerve cord. X75.

Figures 4 to 6. Drawings of sections taken through the brain at various levels, only one-half is shown in each case. X75.

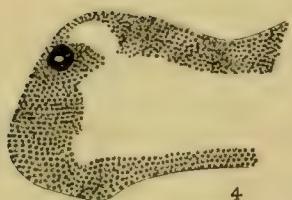




2



3



4



5



6

## Littoral Ascidiants Collected at Laguna Beach

The specimens reported upon are from a collection made by P. A. Lichti during the summer of 1915, and from a small collection brought in during the summer of 1916. The determinations of all but the fifth were kindly made by Prof. W. E. Ritter.

### *Ascidia californica* Ritter and Forsythe

These simple forms were found quite abundantly under stones and in kelp holdfasts. The form of the body was determined largely by the position the animal took on the stone or seaweed.

### *Styela barnharti* Ritter and Forsythe

The specimens obtained were young, simple, of a reddish-brown color and about 4 mm. high. They were found under stones at low tide but not as commonly as some others.

### *Styela montereyensis* Dall

A single specimen of this large, simple species was taken just off shore. It was slender at the base, expanded near the openings and of a reddish-brown color.

### *Euherdmania claviformis* Ritter

This slender species was often found in clusters under stones. They were about 2 mm. in diameter and 10-20 mm. long, sometimes free from sand, at other times covered with sand grains.

### *Goodsiria dura* Ritter

Bright red or orange masses of these were often found in bits of seaweed from deeper water. The individuals were 2 to 3 mm. across and often closely massed on the seaweed or other support.

### *Eudistoma diaphones* Ritter and Forsythe

This was the common compound species found closely attached to the lower sides of stones. It was often quite extensive but not thick or colored.

### *Eudistoma psamion* Ritter and Forsythe

Great masses of this tough, pinkish or slightly colored form were found under rock ledges. It resembles one of the sponges in

general appearance and is found in among sponges and polyzoans. This was one of the most bulky forms which we found.

*Glossophorum planum* Ritter and Forsythe

Irregular masses of this species were found under rock ledges and under stones. Our specimens are largely covered with sand grains.

*Distaplia occidentalis* Ritter and Forsythe

This compound stalked form was found on a rock ledge at low tide near Salt Creek.

W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

## Summer School at Laguna Beach

The summer school at Laguna Beach during the past season was in many respects the most valuable of the past five or six years. There were more students, more teachers and fully as many visitors. The harvest of specimens was very satisfactory. Many creatures not before gathered here were brought from the near-by waters. *Amphioxus* was obtained here for the first time, as well as many other interesting and valuable specimens.



Several new courses were offered. A course in Ecology was given by Professor Bean. In this the local distribution of animals was especially studied. A similar course is to be offered this summer to those who have had some zoology. It is believed that this work will bring greater and greater advantages to us here as we come to know the local conditions better. In the nature of the material this will always be to a large extent a field study.

The course in birds given by Professor Nininger was interesting and valuable. A number of new records for this region were obtained during the summer.



For the first time Miss Hills gave a course in drawing in connection with zoological subjects. This much-needed and valuable work will be continued during the coming summer, not only in a special course, but also in an optional way in connection with several of the other courses.



In connection with the ecology especially, more off-shore collecting was done than ever before. A number of longer trips were found interesting and valuable. Laguna at all times offers attractive walks and many short trips were taken by all classes. Some of these were for a few miles along the coast, back in the hills or by water or land for a considerable distance.

The rocks and coves were again explored, yet much remains unknown. Many new specimens to the locality were found, some of these were from deeper water, rare fish, large sea cucumbers, a large number of strange crabs and many other smaller but no less interesting creatures.

As in the past, a number of workers from other institutions used the private laboratories. The eight research rooms were in use most of the time by those doing more advanced work. It is expected that there will be a number of advanced workers from the northern and eastern universities during the coming season. For the first time the laboratory is provided with a satisfactory lighting system. Electricity is now established at Laguna Beach and the laboratory and tent city are well provided with an ample lighting system.

The tent city and dining hall will again offer accommodations at reasonable prices. The cost of tuition is \$7.50 general charge and \$3.00 an hour per hour taken. By an hour is meant the equivalent of an hour's work in a regular college semester. There are eight private rooms for special investigators.

For further information write to the Director, William A. Hilton, Pomona College, Claremont, Cal. (Laguna Beach, Cal., from June 26 to September 20.)

# Courses Offered at the Summer School of the Laguna Beach Biological Laboratory 1917

To reach Laguna Beach from Los Angeles take the electric or Santa Fe to Santa Ana. From Santa Ana a morning stage leaves at ten, an afternoon stage at four.

Work begins June 27 and regular courses last six weeks, but the laboratory is open all summer.

No one may register for more than six hours. By an hour is included the equivalent of an hour's work during a regular college semester.

The staff of the Laguna Marine Laboratory for the summer will be as follows, several others from eastern institutions may be added later.

William A. Hilton, Pomona College, Director	<i>Zoology</i>
Dr. R. V. Chamberlin, Harvard University Museum of Comparative Zoology	<i>Zoology</i>
E. O. Essig, Department of Entomology University of California	<i>Entomology</i>
Anna A. Hills	<i>Scientific Drawing</i>

1. S. B. 11. Zoology (2 hours). A synopsis of marine invertebrates. Lectures and class exercises with early morning field trips. Prerequisite Biology A1, or open to those who are taking some other biological work. M. to F. at 8.
- 1a. S. B. 11. Zoology. Marine invertebrates (1 hour if taken with 1, or 2 hours). Laboratory on typical local forms. Mornings 9 to 12, except Saturday.
2. S. B. 18. General Entomology (2 to 3 hours). Class laboratory and field work in the general study of local insects. Prerequisite Biology A1, or Zoology B11, or may be accompanied by one of these. Class period M. to F. at 11. Laboratory and field work at hours to be arranged.

3. S. A1. General Biology (3 hours). A beginning course dealing with general principles. Open to those who have had no biological work and who have either entered college or are about to enter. Class periods M. to F. at 11. Laboratory and field work afternoons.
4. S. C. 4. Ecology (2 or 3 hours). Class, field and laboratory work at hours to be arranged. A study of local land and aquatic societies and the factors governing the distribution of marine, fresh water and land forms. Prerequisite, a year of biological work. Class periods M. W. F. at 1.
5. S. C. 5. Nature Study (2 or 3 hours). Methods and materials for nature study. This will be given in the evening when a lantern may be used. A general view of the whole field will be given either for those who are teaching, those who intend to teach, or those who desire the general not technical information. This is not a course for college credit. M. to F. evening at 7:30. Laboratory and field work to be arranged. This will be given by a number of teachers.
7. S. D. 7. Mammalian Embryology (2 hours). Laboratory work with serial sections of embryos. Prerequisite two years of zoological work. A review course for those in the practice of medicine or preparing for medical work. Hours to be arranged.
8. S. D. 8. Neurology (2 or 3 hours). Laboratory work with sections of the human brain and cord. A review course open only to those who have some knowledge of the central nervous system of vertebrates. Especially designed for those who have interest in Neurology, Psychology or Medicine.

In addition to these courses special C. or D. work for 2 or 3 hours may be taken as follows:

- a. Special field and laboratory work with some group of marine animals, such as amphipods, isopods, decapods, gastropods, etc.
- b. Special field and laboratory work in Entomology, either with some single order or family, or life history work.

- c. Special field and laboratory work in the embryology of invertebrates.
- d. Special field and laboratory work in Ecology. Hours to be arranged.
- e. Special field and laboratory work in marine algæ. Hours to be arranged.

The following work in art will be offered by Miss Anna A. Hills:

- 1. S. A1. Art (2 hours) zoological drawing. A beginning course for students of Biology with marine and land specimens as material. This course will be an aid to any who may wish to prepare illustrations for scientific papers or books. Pen and ink, pencil and colored methods will be given. Tuition the same as in other courses. Students furnish their own drawing materials.
- 2. Outdoor sketch class with either water colors or oils—oils preferred.
- 3. Outdoor figure work. Especially arranged for if desired by those who have done out-of-door work.

Rates for two and three, 75 cents per hour. Each should be taken in three periods of three hours each.

Miss Hills has had the following preparation: Student in Olivet College, Art Institute, Chicago; Graduate of Cooper Union, New York City; special work under Rhoda Holmes Nicholls and Arthur W. Dow, New York. During four years study in Europe worked under Wilhelmina H. de Koning in Holland, Jean Paul Laurens and William Lappara in Julian's Academy, Paris, and in England two years out of doors under J. Noble Barlow.



# Preliminary List of Birds From the Claremont-Laguna Region

This list is compiled from many local sources. The earliest records of the Department of Zoology of Pomona College were by Illingsworth, later by Chas. Metz, by Leon L. Gardner and others. There is also included the local records of Wright M. Pierce, and Halsted White. The drawings are all from bird skins from the collections of Pierce and White and from the Department of Zoology of Pomona College. The drawings are by Miss Hazel Burnham. For criticisms, suggestions and much valuable material we have especially to thank Mr. Halsted White and Mr. Wright M. Pierce. Grinnell's "Distributional List of the Birds of California," was used as a basis in the use of the names.

In the list the initials after a record or statement denotes the authorship. Unless otherwise indicated the specimens drawn were males.

The figures on the last two plates are reduced one-half. Other figures are reduced one-third, the figures of the pelicans, condor and vulture are reduced more.

*Aechmophorus occidentalis* Law. Western Grebe. H.W.

*Colymbus nigricollis californicus* Heerm. American Eared Grebe. H.W. Seen occasionally in winter on ponds near Santa Ana river near Corona. W.M.P. Pl. I. Fig. 1.

*Podilymbus podiceps* Linn. Pie-billed Grebe. H.W. Seen at times near fresh water ponds at Corona. W.M.P. Pl. I. Fig. 2.

*Gavia immer* Brun. Balboa. L.L.G. Common Loon.

*Gavia pacifica* Lawr. Laguna Beach. L.L.G. Pacific Loon.

*Ptychoramphus aleuticus* Pall. Cassin Auklet. H.W.. Pl. I. Fig. 3.

*Uria troille californica* H. Bry. California Murre. One taken in winter at Newport Beach by A. Van Rossen. W.M.P.

*Larus glaucescens* Naum. Glaucous-winged Gull. Seen. H.W.

*Larus occidentalis* Aud. Western Gull. Laguna, Balboa. H.W. and L.L.G. Noted at all seasons along the coast, most commonly in fall and winter. W.M.P. Pl. I. Fig. 4.

*Larus delawarensis* Ord. Ring-billed Gull. Metz and H.W. Pl. I. Fig. 6.

*Larus heermanni* Cassin. Heermann Gull. Balboa. L.L.G. Pl. I. Fig. 5.

*Larus philadelphia* Ord. Bonaparte Gull. H.W. Pl. I. Fig. 7. Noted in flocks in spring, Nigger Slough, Los Angeles county. W.M.P.

*Sterna paradisaea* Brun. Arctic Tern. Near Laguna Beach, May 1, 1915. H.W. Pl. I. Fig. 8.

*Sterna antillarum* Less. Least Tern. H.W. Laguna Beach. L.L.G. Breeding on beach near Newport, June, 1916. W.M.P. Pl. I. Fig. 9.

*Hydrochelidon nigra surinamensis* Gmel. Black Tern. H.W. One taken on fresh water pond near Corona, May 18, 1915. W.M.P. Pl. I. Fig. 10.

*Puffinus griseus* Gmel. Dark-bodied Shearwater. Ten or twelve miles from shore near Laguna Beach, in flocks over schools of fish. H.H.N.

*Phalacrocorax auritus albociliatus* Ridg. Farallon Cormorant. Seen H.W. Pomona Davenport. Found at all times on reservoirs near Claremont; also seen in fall and winter on fresh water ponds near Corona. W.M.P. Pl. I. Fig. 11.

*Pelecanus erythrorthynchos* Gmel. White Pelican. Often seen on migrations. H.W., W.M.P., L.L.G. Pl. I. Fig. 13.

*Pelecanus californicus* Ridg. California Brown Pelican. Often seen at Laguna Beach. Pl. I. Fig. 12.

*Mergus serrator* Linn. Red-breasted Merganser. Balboa. H.W. L.L.G. Pl. I. Fig. 14.

*Lophodytes cucullatus* Linn. Hooded Merganser. Specimen, no record. Pl. I. Fig. 15.

*Anas platyrhynchos* Linn. Mallard. H.W. Fairly common in fall and winter, lowlands near Corona and Santa Ana river. Many specimens taken. A few pairs possibly remain and breed in the same region. W.M.P. Pl. II. Fig. 1.

*Chaulelasmus streperus* Linn. Gadwall. Seen H.W. Rather rare visitant to fresh water ponds near Corona. W.M.P.

*Mareca americana* Gmel. Baldpate. H.W. Rather abundant, certain winters, fresh water ponds near Corona, often in large flocks. W.M.P. Pl. II. Fig. 2.

*Nettion carolinense* Gmel. Green-winged Teal. H.W. Abundant some years, November to March. Always common. Pl. II. Fig. 3.

*Querquedula cyanoptera* Vieil. Cinnamon Teal. Laguna Beach. L.I.G., H.W. Fairly abundant early fall, less common in mid-winter. Scattering pairs breed in marshes near Corona. W.M.P. Pl. II. Fig. 4.

*Spatula clypeata* Linn. Shoveller. H.W. Abundant, fall and winter Santa Ana river and ponds. W.M.P. Pl. II. Fig. 5.

*Dafila acuta* Linn. Pintail. H.W. Very abundant from Oct. 15 to Dec. 1, or later. Large flocks seen in spring, Corona, Santa Ana river. W.M.P. Pl. II. Fig. 6.

*Marila americana* Eyt. Redhead. H.W. Occasionally taken on fresh water ponds near Corona. W.M.P. Pl. II. Fig. 7.

*Marila valisineria* Wil. Canvas-back. H.W. Occasionally taken on ponds near Corona. W.M.P. Pl. II. Fig. 8.

*Marila marila* Linn. Greater Scaup Duck. H.W. Pl. II. Fig. 9.

*Marila collaris* Donov. Ring-necked Duck. One taken Dec. 12, 1915, fresh water pond near Corona. (Recorded in Condor.) W.M.P.

*Charitonetta albeola* Linn. Buffle-head. Seen H.W. Rare, seen once on pond near Corona. W.M.P. Pl. II. Fig. 10.

*Oidemia deglandi* Bonap. White-winged Scoter. H.W. Pl. II. Fig. 11.

*Erismatura jamaicensis* Gmel. Ruddy Duck. Laguna Beach Gardner. H.W. Common in small flocks, pairs or individuals, fall and winter, fresh water ponds near Corona. W.M.P. Pl. II. Fig. 12.

*Dendrocygna bicolor* Vieil. Fulvous Tree Duck. Claremont, June 30, 1897. Illingsworth. Pl. II. Fig. 13.

*Plegadis guarauna* Linn. White-faced Glossy Ibis. Rather uncommon. In Oct., 1916, two birds seen on fresh water ponds near Corona. W.M.P.

*Botaurus lentiginosus* Montag. American Bittern. H.W. Common in marsh and lowland near Corona, Chino, El Monte. Seen as late as April. Probably nests. W.M.P. Pl. II. Fig. 14.

*Ardea herodias hyperonca* Oberh. California Great Blue Heron. H.W. Laguna Beach. L.L.G. Breeding colony near Laguna Beach, April 23, 1917, eight or ten nests with young one-fourth to one-half grown. One nest with two eggs. Often seen near Corona and Chino standing in barley or beet fields. W.M.P. Pl. II. Fig. 15.

*Butorides virescens anthonyi* Mear. Anthony Green Herron. H.W. Several seen in San Dimas Canyon in early spring; also seen near Corona in river bottoms. W.M.P. Pl. II. Fig. 16.

*Nycticorax nycticorax naevius* Bodd. Black-crowned Night Heron. H.W. Claremont. L.L.G. In spring in Santa Ana river bottoms near Corona. W.M.P. Pl. II. Fig. 17.

*Rallus obsoletus* Ridg. California Clapper Rail. In swampy tracts about Balboa. H.H.N.

*Rallus virginianus* Linn. Virginia Rail. H.W. Many records, fall, winter, spring, near Chino and Corona. W.M.P. Pl. III. Fig. 1.

*Porzana carolina* Linn. Sora Rail. H.W. Same records as Virginia Rail. W.M.P. Pl. III. Fig. 2.

*Coturnicops noveboracensis* Gmel. Yellow Rail. One record, Corona. Pierce Condor XVI, 1914. W.M.P.

*Gallinula galeata* Licht. Florida Gallinule. Corona. H.W. Seen at times in fall near Corona. W.M.P. Pl. III. Fig. 3.

*Fulica americana* Gmel. Coot. H.W. Laguna Lakes. L.L.G. Very abundant near Corona. Breeds. W.M.P. Pl. III. Fig. 4.

*Phalaropus fulicarius* Linn. Red Phalarope. One record from near Corona. W.M.P.

*Steganopus tricolor* Vieil. Wilson Phalarope. H.W. Three records from fresh water ponds near Corona. W.M.P. Pl. III. Fig. 5.

*Himantopus mexicanus* Mull. Black-necked Stilt. H.W. Several in spring on fresh water ponds near Corona. W.M.P. Pl. III. Fig. 6.

*Gallinago delicata* Ord. Wilson Snipe. H.W. Common in fall and winter and spring, in wet fields near Corona and Chino. W.M.P. Pl. III. Fig. 7.

*Macrorhamphus griseus scolopaceus* Say. Long-billed Dowitcher. Balboa. L.L.G. Pl. III. Fig. 8.

*Pisobia minutilla* Vieil. Least Sandpiper. Long Beach. Metz. Flocks of twelve or fifteen seen at times on ponds near Corona. W.M.P. Pl. III. Fig. 9.

*Ereunetes mauri* Cab. Western Sandpiper. H.W. Long Beach. Metz. Pl. III. Fig. 10, female.

*Calidris leucophaea* Pall. Sanderling. H.W. Pl. III. Fig. 12.

*Totanus melanoleucus* Gmel. Greater Yellow-legs. H.W. Pl. III. Fig. 13. Corona ponds, fall and winter. W.M.P.

*Catoptrophorus semipalmatus inornatus* Brew. Western Willet. H.W. Pl. III. Fig. 14.

*Heteractitis incanus* Gmel. Wandering Tattler. Taken near Laguna Beach by H.W.

*Actitis macularius* Linn. Spotted Sandpiper. H.W. Fall, winter, spring; rocky coves near Laguna Beach. W.M.P. Pl. III. Fig. 11.

*Numenius americanus* Bech. Long-billed Curlew. H.W. Seen at Balboa in spring. W.M.P. Pl. III. Fig. 17.

*Numenius hudsonicus* Lath. Hudsonian Curlew. H.W. Balboa. L.L.G. Fall, winter, spring, Balboa, Newport, Laguna. W.M.P. Pl. III. Fig. 16.

*Squatarola squatarola* Linn. Black-bellied Plover. H.W. Same localities as last, not so abundant in winter. W.M.P. Pl. III. Fig. 18.

*Oxyechus vociferus vociferus* Linn. Killdeer. H.W. Laguna Gardner. Near Claremont, fall; Chino, Corona, Newport. Breed near Chino, Newport. W.M.P. Pl. III. Fig. 19.

*Aegialitis semipalmata* Bonap. Semipalmated Plover. Balboa. L.L.G.

*Aegialitis nivosa* Cass. Snowy Plover. H.W. Long Beach. Metz. Several pairs near Newport, 1916. Near Balboa at all seasons. W.M.P. Pl. III. Fig. 20.

*Arenaria melanocephala* Vig. Black Turnstone. H.W. Several records near Laguna. W.M.P. Pl. III. Fig. 21.

*Oreortyx picta plumifera* Goul. Mountain Quail. H.W. Recorded from Brown's Flats, San Antonio Canyon, Camp Baldy, Bear Flats, Palmers Canyon. W.M.P. Pl. III. Fig. 23.

*Lophortyx californica vallicola* Ridg. Valley Quail. H.W. Claremont, Santa Ana, Laguna, Lytle Creek up to 5000 ft. Breeds in April, 10 to 24 eggs. W.M.P. Pl. III. Fig. 22.

*Colomba fasciata fasciata* Say. Band-tailed Pigeon. Oct. 1916. H.W. Claremont. Metz. Abundant in San Dimas Canyon at certain seasons, usually in large flocks, less common than formerly. Found at Glen Ranch in Lytle Creek. W.M.P. Pl. III. Fig. 25.

*Zenaidura macroura marginella* Woodh. Western Mourning Dove. H.W. Quite abundant, less so than formerly. W.M.P. Pl. III. Fig. 24.

*Gymnogyps californianus* Shaw. California Condor. One specimen in the department, supposed to have been obtained from hills near Pomona about fifteen years ago. Pl. IV. Fig. 1.

*Cathartes aura septentinalis* Wied. Turkey Vulture. L.L.G., H.W. Claremont, Chino, Laguna. Abundant. W.M.P. Pl. IV. Fig. 1.

*Circus hudsonius* Linn. Marsh Hawk. H.W. Noted from foothills near Etiwanda to Santa Ana river bottoms near Santa Ana. Breeding record near Corona. W.M.P. Pl. IV. Fig. 3.

*Accipiter velox* Wil. Sharp-shinned Hawk. H.W. Common fall, winter and early spring, mountains to lowlands. W.M.P. Pl. IV. Fig. 4.

*Accipiter cooperi* Bonap. Cooper Hawk. H.W. Resident in small numbers; most abundant in fall and winter. Breeds in mountain canyons. Recorded from Lytle Creek, San Gabriel, etc. W.M.P. Pl. IV. Fig. 5.

*Buteo borealis calurus* Cass. Western Red-tailed Hawk. H.W., Illingworth, Metz. Common breeding from coast to mountains. W.M.P. Pl. IV. Fig. 7.

*Buteo lineatus elegans* Cass. Red-bellied Hawk. H.W. Probably becoming scarcer every year. A few pairs still breed in river bottoms near Corona. W.M.P. Pl. IV. Fig. 6.

*Buteo swainsoni* Bonap. Swainson Hawk. Found breeding in several instances in river bottom near Corona, also near Chino. Large flocks often seen flying north or south. W.M.P. Pl. IV. Fig. 8.

*Archibuteo ferrugineus* Licht. Ferruginous Rough-legged Hawk. Rather uncommon. One taken near Corona. Another seen in fall of 1916. W.M.P.

*Aquila chrysaetos* Linn. Golden Eagle. H.W., Metz. In high mountains. W.M.P. Pl. IV. Fig. 9.

*Haliaeetus leucocephalus leucocephalus* Linn. Southern Bald Eagle. Near Laguna and San Pedro. W.M.P., L.L.G.

*Falco mexicanus* Schl. Prairie Falcon. H.W. Not common, fall and winter near Chino. W.M.P. Pl. IV. Fig. 10.

*Falco columbarius columbarius* Linn. Northern Pigeon Hawk. Rather uncommon. Several taken, all probably this form. Pl. IV. Fig. 11.

*Falco sparverius sparverius* Linn. American Sparrow Hawk. H.W., L.L.G., Metz, Illingsworth. From the mountains to the sea. W.M.P. Pl. IV. Fig. 12, male. Fig. 13, female.

*Pandion haliaetus carolinensis* Gmel. American Osprey. Between Laguna and Balboa, summer, 1916. H.H.N. Seen near Newport. W.M.P.

*Aluco pratincola* Bonap. American Barn Owl. Metz., L.L.G., H.W. Very common, San Dimas Canyon, Claremont, Chino, near Corona, Upland, Laguna. Nests in holes in trees or rocks or in buildings. Eggs from February to May. W.M.P. Pl. IV. Fig. 14.

*Asio wilsonianus* Less. Long-eared Owl. H.W., Metz. June 7, 1909. One record from Indian Hill, Claremont. Several pairs nesting in willow bottoms near Corona, April, 1915 to 1917. W.M.P. Pl. IV. Fig. 15.

*Asio flammeus* Pontop. Short-eared Owl. H.W. Hills near Pomona, Nov. 10. Near Corona, Nov. 3. Near Ontario in grain field, Nov. 2. W.M.P. Pl. IV. Fig. 16.

*Strix occidentalis occidentalis* Xan. Southern Spotted Owl. One record from San Gabriel Canyon, May 1, 1916. W.M.P.

*Otus asio querquinus* Grin. Southern California Screech Owl. Illingsworth, H.W. Abundant, Claremont, resident breeding. San Dimas and San Antonio Canyons, many records. W.M.P. Pl. IV. Fig. 17.

*Bubo virginianus pallescens* Stone. Western Horned Owl. One record. Found dead at mouth of San Antonio Canyon, Jan. 10, 1915. W.M.P.

*Bubo virginianus pacificus* Cass. Pacific Horned Owl. Pair seen at Laguna, 1917; San Antonio Canyon, 1914. Breeding in San Dimas Canyon, Feb. and March, 1917. W.M.P. Pl. IV. Fig. 18.

*Speotyto cunicularia hypogaea* Bonap. Burrowing Owl. Illingsworth, 1902; Metz, H.W. Near Santa Ana and Irvine. Abundant in fields near Chino and Corona, nesting. Near Claremont, nesting. Nigger Slough, nesting. W.M.P. Pl. IV. Fig. 19.

*Glaucidium gnoma californicum* Sclat. California Pigmy Owl. One record, San Antonio Canyon. W.M.P. Pl. IV. Fig. 20.

*Geococcyx californianus* Less. Road Runner. H.W. Claremont. Illingsworth, '96; L.L.G. Laguna, 1914. Formerly much more common. W.M.P. Pl. V. Fig. 1.

*Coccyzus americanus occidentalis* Ridg. California Cuckoo. Seen H.W. Rather uncommon. Several individuals seen at Corona in willows; one set of three eggs found near Chino. Pl. V. Fig. 2.

*Ceryle alcyon caurina* Grin. Western Belted Kingfisher. H.W. Noted in migration near Claremont, San Gabriel Canyon, San Antonio Canyon, Glen Ranch, Santa Ana river near Corona. W.M.P. Seen in Pudding Stone Canyon. L.L.G. Pl. V. Fig. 3.

*Dryobates villosus hyloscopus* Canab. and Hein. Cabinas Wood-pecker. H.W. Common in nesting season in higher mountains. Taken in fall in Santa Ana river bottoms and also near El Monte. W.M.P. Pl. V. Fig. 4. Bright red patch on head.

*Dryobates pubescens turati* Malhe. Willow Woodpecker. H.W. Common in willow bottoms near Corona in spring; also El Monte. One taken in San Antonio and one in San Dimas Canyons in the fall. W.M.P. Pl. V. Fig. 5. Bright red line back of black patch on head.

*Dryobates scalaris cactophilus* Ober. Cactus Woodpecker. H.W. Several records for Mojave desert. Breeding near Victorville. W.M.P.

*Dryobates nuttalli* Gamb. Nuttall Woodpecker. Common in canyons up to 5000 feet; also in willow and sycamore groves in lowlands. Nesting, May, 1916, San Gabriel Canyon, Santa Ana river bottoms near Corona, San Antonio Canyon. W.M.P. Pl. V. Fig. 6. Bright red patch back of black patch on head.

*Xenopicus albolarvatus gravirostris* Grinn. San Bernardino White-headed Woodpecker. Found in the higher mountains of the San Gabriel range, Baldy, Ontario, etc., in summer. W.M.P. Pl. V. Fig. 7. Bright red patch on head.

*Sphyrapicus varius daggetti* Grinn. Sierra Red-breasted Sapsucker. H.W. Several winter records. W.M.P.. Pl. V. Fig. 8. Head and throat bright red, shaded into yellow on breast.

*Melanerpes formicivorus bairdi* Ridg. California Woodpecker. H.W., Metz. Nesting and resident. W.M.P. Pl. V. Fig. 9. Bright red patch on back of head, yellow tinge on throat.

*Asyndesmus lewisi* Riley. Lewis Woodpecker. Common Brown's Flats in spring. H.W. Casual migrant, noted years ago in Blanchard Park, Claremont, in small numbers in spring. W.M.P. Pl. V. Fig. 10. Red spot on front of head, breast streaked with red.

*Colaptes cafer collaris* Vigors. Red-shafted Flicker. H.W., Metz, H.H.T. Laguna. L.L.G. Abundant, especially fall and winter. Breeds San Antonio Canyon, Santa Ana river bottom. W.M.P. Pl. V. Fig. 11. Red streak on side of throat, under tail and red wing quills.

*Phalaenoptilus nuttalli californicus* Ridg. Dusky Poor-will. H.W. Fairly common at mouth of San Antonio and San Dimas Canyons in spring. Noted in upper Lytle Creek, Sept., 1915, and Glen Ranch, 1916. W.M.P. Pl. V. Fig. 12.

*Chordeiles virginianus hesperis* Grinn. Pacific Nighthawk. Found only in Big Bear Valley. Possibly occurs in our mountains. W.M.P. Pl. V. Fig. 13.

*Chordeiles acutipennis texensis* Law. Texas Nighthawk. H.W. Common about Claremont. W.M.P., Metz. Laguna. H.H.N.

*Chaetura vauxi* Towns. Vaux Swift. Noted in fall migration, Santa Ana river. W.M.P.

*Aeronautes melanoleucus* Baird. White-throated Swift. H.W. Capistrano. H.H.N. Noted in migration in fall, Santa Ana river bottoms. Taken along cliffs near Laguna. Spring. W.M.P. Pl. V. Fig. 14.

*Archilochus alexandri* Bou. and Mul. Black-chinned Hummingbird. H.W. Nestings San Antonio Canyon, near Corona, near Ontario. W.M.P.

*Calypte costae* Bour. Costa Hummingbird. H.W., Metz. Abundant in mountains and lower. W.M.P. Pl. V. Fig. 15. Throat purple.

*Calypte anna* Less. Anna Hummingbird. Metz, H.W. Common all year, nests in Claremont. W.M.P. Pl. V. Fig. 16. Red throat.

*Selasphorus rufus* Gmel. Rufous Hummingbird. H.W., Metz. Common migrant in spring. W.M.P. Pl. V. Fig. 17. Breast brownish, some red spots which are small. Back more brown than others.

*Tyrannus verticalis* Say. Western Kingbird. H.W. Laguna. L.L.G. Common and nesting, Chino, San Antonio Canyon. W.M.P. Pl. V. Fig. 18. Streak of red on center of head.

*Tyrannus vociferans* Swains. Cassin Kingbird. H.W. Laguna Gardner. Common migrant near Chino. No nesting records. W.M.P. Pl. V. Fig. 19. Red streak, center of head.

*Myiarchus cinerascens* cinerascens Law. Ash-throated Flycatcher. H.W. Claremont. Metz. Laguna. L.L.G. Common about Claremont in migrations. Breeding in some of the canyons. W.M.P. Pl. V. Fig. 20.

*Sayornis sayus* Bonap. Say Phoebe. H.W. Claremont. Metz. Laguna L.L.G. Common, fall and winter; possibly a few pairs breed. W.M.P. Pl. V. Fig. 25.

*Sayornis nigricans* Swain. Black Phoebe. H.W. Laguna Gardner. Common from ocean to mountains and into canyons. Many nesting records. W.M.P. Pl. V. Fig. 24.

*Nuttallornis borealis* Swains. Olive-sided Flycatcher. H.W. Claremont. Metz. Common in higher mountains. Found in valleys during migrations. W.M.P. Pl. V. Fig. 21.

*Myiochanes richardsoni richardsoni* Swains. Western Wood Pewee. H.W. Abundant and nests in canyons, in valley during migrations. W.M.P. Pl. V. Fig. 26.

*Empidonax difficilis difficilis* Baird. Western Flycatcher. H.W. Summer resident of canyons; many nesting records for Cucamonga, San Dimas, San Gabriel Canyons. W.M.P.

*Empidonax traillii traillii* Audub. Traill Flycatcher. H.W. Summer visitant to willow bottoms and in less numbers to canyons. W.M.P. Pl. V. Fig. 22.

*Empidonax hammondi* Xanthus. Hammond Flycatcher. One record San Dimas Canyon. W.M.P.

*Pyrocephalus rubinus mexicanus* Sclat. Vermilion Flycatcher. One record Santa Ana river bottom near Corona in winter. W.M.P.

*Otocoris alpestris actia* Oberh. California Horned Lark. H.W. Claremont. Metz. Laguna. L.L.G. Abundant, resident. W.M.P. Pl. V. Fig. 27.

*Cyanocitta stelleri frontalis* Ridg. Blue-fronted Jay. H.W. Common resident of mountains from 3,000 to 9,000 feet. One breeding date, May, 1915, San Gabriel Canyon. W.M.P. Pl. V. Fig. 28.

*Aphelocoma californica californica* Vig. California Jay. H.W. Claremont. Metz. Laguna. L.L.G. Abundant, Claremont and lower canyons. W.M.P. Pl. V. Fig. 29. Bright blue.

*Corvus corax sinuatus* Wag. Western Raven. Seen. H.W. Laguna. L.L.G., H.H.N. and W.M.P. Pl. V. Fig. 33.

*Corvus brachyrhynchos hesperis* Ridg. Western Crow. H.W. Very abundant on willow river bottoms, Corona, El Monte. Nest on Santa Ana. W.M.P. Also seen near south hills near Pomona. Pl. V. Fig. 32.

*Nucifraga columbiana* Wilson. Clarke Nutcracker. H.W. Noted on the high slopes of Mount San Antonio. W.M.P. Pl. V. Fig. 31.

*Cyanocephalus cyanocephalus* Wied. Pinyon Jay. Seen in flocks in spring of 1917 near Box S Ranch on Mojave Desert. Records for San Bernardino Range, not for San Gabriel. W.M.P. Pl. V. Fig. 30. Bluish grey.

*Molothrus ater obscurus* Gmel. Dwarf Cowbird. Eggs probably of this species found in Santa Ana river flats near Corona on several occasions. W.M.P.

*Xanthocephalus xanthocephalus* Bonap. Yellow-headed Blackbird. H.W. Collected during migration in spring near Chino, and nesting near Nigger slough. W.M.P. Pl. V. Fig. 34.

*Agelaius phoeniceus neutralis* Ridg. San Diego Red-winged Blackbird. H.W. Very abundant in lowlands about Chino. W.M.P. Pl. V. Fig. 35.

*Agelaius tricolor* Audub. Tri-colored Red-winged Blackbird. H.W. Several specimens taken near Corona, Chino, etc. W.M.P.

*Sturnella neglecta* Audub. Western Meadowlark. H.W., Metz. Abundant in lowlands common about Claremont. W.M.P. Pl. V. Fig. 36. Canary yellow on throat, side and breast.

*Icterus parisorum* Bonap. Scott Oriole. H.W. Quite common on Mojave Desert. W.M.P. Pl. V. Fig. 38. Black and very deep yellow.

*Icerus cucullatus nelsoni* Ridg. Arizona Hooded Oriole. H.W. Claremont. Metz. Laguna. L.L.G. Locally common at Ontario, Claremont, Pomona, etc. Many nesting dates, usually nesting in palms. W.M.P. Pl. V. Fig. 37. Black and very deep yellow.

*Icterus bullocki* Swains. Bullock Oriole. H.W. Claremont. Metz. Abundant from ocean to 5,000 feet. Breeding at Hesperia. W.M.P. Pl. V. Fig. 39. Black and orange.

*Euphagus cyanocephalus* Wag. Brewer Blackbird. H.W., Metz. Especially abundant in Claremont. Many records. W.M.P.

*Carpodacus purpureus californicus* Baird. California Purple Finch. H.W. Winter visitant to Claremont, San Antonio Canyon. W.M.P. Pl. VI. Fig. 1. Head and throat a rich red.

*Carpodacus cassini* Baird. Cassin Purple Finch. H.W. Claremont. Metz. Winter migration record for Claremont, Pomona,

San Antonio Canyon. W.M.P. Pl. VI. Fig. 2. Top of head rich red, thorax and sides tinged with red.

*Capodacus mexicanus frontalis* Say. California Linnet. H.W. Claremont. Metz. Laguna. L.L.G. Abundant from ocean to mountains. Less common above 3,000 feet. Nests about buildings and in cactus. W.M.P. Pl. VI. Fig. 3. Head and throat rich red.

*Astragalinus tristis salicamans* Grinn. Willow Goldfinch. H.W. Claremont. Metz. Redlands, San Antonio Station; very abundant El Monte, Corona. Many nesting records in bottoms. W.M.P. Pl. VI. Fig. 4. Breast and neck canary yellow.

*Astragalinus psaltria hesperophilus* Ober. Green-backed Goldfinch. H.W. Claremont. Metz. Claremont, San Antonio Canyon, Corona, Laguna. Common. Breeding San Antonio Canyon. Claremont, near Covina. W.M.P. Pl. VI. Fig. 5. Breast canary yellow, back yellowish-green.

*Astragalinus lawrencei* Cass. Lawrence Goldfinch. H.W. Breeding in Claremont, San Antonio Canyon, near Corona. Found also in upper San Gabriel. W.M.P. Pl. VI. Fig. 6. Canary yellow breast, streaks on wings.

*Spinus pinus pinus* Wilson. Pine Siskin. Common winter visitor to San Antonio and other parts of mountains. W.M.P. Pl. VI. Fig. 7.

*Passer domesticus* Linn. English Sparrow. H.W. Noted at Claremont, Pomona, Ontario, San Bernardino, Victorville, Hesperia, El Monte, Box S. Ranch. W.M.P. Pl. VI. Fig. 8.

*Pooecetes gramineus confinis* Miller. Western Vesper Sparrow. H.W. Several records, fall and winter, Corona, Chino, near Etiwanda. W.M.P. Pl. VI. Fig. 9.

*Pooecetes gramineus affinis* Miller. Oregon Vesper Sparrow. Probably occurs. H.W.

*Passerculus sandwichensis alaudinus* Bonap. Western Savanna Sparrow. H.W. Abundant in lowlands, winter and fall. W.M.P. Pl. VI. Fig. 11.

*Passerculus rostratus rostratus* Cass. Found quite commonly near Oceanside. October 19, 1916. W.M.P.

*Passerculus beldingi* Ridg. Belding Marsh Sparrow. Common at Newport. One breeding record. W.M.P. Pl. VI. Fig. 12.

*Ammodramus savannarum bimaculatus* Swain. Western Grass-hopper Sparrow. H.W. Records as follows: One male, near Corona, Calif.; one female, mouth of Lytle Creek Canyon, September 11, 1915; May 22, 1915, several Nigger Slough, near San Pedro. W.M.P. Pl. VI. Fig. 13.

*Chondestes grammacus strigatus* Swain. Western Lark Sparrow. H.W. Claremont. Metz. Laguna. L.L.G. Abundant near Corona, Chino, mouth of Lytle Creek Canyon; fairly common Mojave Desert. Claremont. W.M.P. Pl. VI. Fig. 17.

*Zonotrichia leucophrys leucophrys* Forst. White-crowned Sparrow. North of Claremont. In college collection. H.W. Two records, near Claremont. Specimen from desert in spring. W.M.P. Pl. VI. Fig. 18.

*Zonotrichia leucophrys gambeli* Nutt. Intermediate Sparrow. H.W. Very abundant ocean to foothills, fall and winter. Recorded late in April from Claremont. W.M.P. Pl. VI. Fig. 19.

*Zonotrichia coronata* Pall. Golden-crowned Sparrow. H.W. Winter, San Dimas, upper San Antonio, along foothills. W.M.P. Pl. VI. Fig. 15.

*Spizella passerina arizonae* Coues. Western Chipping Sparrow. H.W. Claremont. Metz. Breeding records, Claremont. W.M.P.

*Spizella breweri* Cass. Brewer Sparrow. Migration records in spring, Claremont. W.M.P. Pl. VI. Fig. 16.

*Spizella atrogularis* Caban. Black-chinned Sparrow. Seen. H.W. Migration records in spring. W.M.P. Pl. VI. Fig. 10.

*Junco oreganus thurberi* Anthony. Sierra Junco. H.W., Metz. Common; breeds in mountains, in valleys in spring. W.M.P. Pl. VI. Fig. 14.

*Amphispiza bilineata deserticola* Ridg. Desert Black-throated Sparrow. H.W. One record for Claremont. Specimen in Pomona College collection. Abundant, breeding in desert near Victorville, spring 1917. W.M.P. Pl. VI. Fig. 20.

*Amphispiza belli* Cass. Bell Sparrow. H.W. Claremont. Metz. Common, breeding near Claremont. Found up to San Antonio Canyon. W.M.P. Pl. VI. Fig. 21.

*Amphispiza nevadensis canescens* Grinn. California Sage Sparrow. H.W. Fall; common at Glenn Ranch. W.M.P. Pl. VI. Fig. 22.

*Aimophila ruficeps ruficeps* Cass. Rufous-crowned Sparrow. H.W. Laguna. L.L.G. Resident foothills near Claremont, mouth of San Antonio Canyon. W.M.P. Pl. VI. Fig. 23.

*Melospiza melodia cooperi* Ridg. San Diego Song Sparrow. H.W. Claremont. Metz. Laguna. L.L.G. Very abundant in river bottoms; many breeding records; Claremont to coast. W.M.P. Pl. VI. Fig. 27.

*Melospiza lincolni lincolni* Aud. Lincoln Sparrow. H.W. Winter resident to our valleys. W.M.P. Pl. VI. Fig. 24.

Certain of the fox sparrows are very hard to place. The notes that I give are only provisional and further study of this group may place these under different sub-species. Then there are many intergrades that are difficult to correctly place. The sub-species that are hard to differentiate are as follows:

*Passerella iliaca unalascheensis* Gmel. Shumagin Fox Sparrow. Taken in winter, San Antonio Canyon.

*P. i insularis* Rid. Kadiak Fox Sparrow. Winter, San Antonio Canyon.

*P. i sinuosa* Grinn. Valdez Fox Sparrow. San Dimas Canyon in winter.

*P. i méruloides* Vig. Yakutat Fox Sparrow. Several San Antonio Canyon in winter.

*P. i altivagans* Rid. Alberta Fox Sparrow. Several in winter, San Dimas Canyon. W. M. P.

*Passerella iliaca schistacea* Baird. Slate-colored Fox Sparrow. Taken in winter, San Dimas Canyon; Lytle Creek in fall. W.M.P.

*Passerella iliaca megarhyncha* Baird. Thick-billed Fox Sparrow. Recorded in winter, San Antonio Canyon, San Dimas Canyon. W. M. P.

*Passerella iliaca stephensi* Anth. Stephens Fox Sparrow. H.W. No valley records. W.M.P. Pl. VI. Fig. 26.

*Pipilo maculatus megalonyx* Baird. Spurred Towhee. H.W. Claremont. Metz. Abundant, breeding in Claremont, Corona, San Antonio Canyon, Laguna. W.M.P. Pl. VI. Fig. 28.

*Pipilo crissalis senicula* Anth. Anthony Brown Towhee. H.W. Claremont. Metz. Abundant, breeding Claremont to Laguna. W.M.P. Pl. VI. Fig. 30.

*Oreospiza chlorura* Audub. Green-tailed Towhee. H.W. Breeds on high mountains (about 8,000 feet), Lytle Creek, near Corona in winter. W.M.P. Pl. VI. Fig. 29.

*Zamelodia melanocephala capitalis* Baird. Pacific Black-headed Grosbeak. Metz. Claremont. H.W. Breeding at Claremont, near Corona. W.M.P. Pl. VI. Fig. 31. Female.

*Guiraca caerulea salicarius* Grinn. California Blue Grosbeak. H. W. Laguna. H.H.N. Santa Ana river bottom in spring; Brea Canyon. W.M.P. Pl. VI. Fig. 32. Dark blue, rufous on wings.

*Passerina amoena* Say. Lazuli Bunting. H.W. Claremont. Metz. Fairly common in Claremont, seen in Brea Canyon and near Chino, San Antonio Canyon, San Dimas Canyon. W.M.P. Pl. VI. Fig. 33. Bright blue touched with rufous.

*Calamospiza melanocorys* Stejn. Lark Bunting. One record near Corona, May 11, 1915. W. M. P.

*Piranga ludoviciana* Wilson. Western Tanager. H.W. Common in canyons in summer, upper San Antonio, Cucamonga; breeding records; spring migration records for Claremont. W.M.P. Pl. VI. Fig. 34. Head brilliant red shaded over yellow.

*Progne subis hesperia* Brew. Western Martin. Two specimens in college collection, taken 1896. Pl. VI. Fig. 35. Female.

*Petrochelidon lunifrons lunifrons* Say. Cliff Swallow. H.W. Long Beach. Metz. Laguna Beach Gardner. Breeding. Very abundant from mouth of San Antonio to ocean; nests on barns, houses, etc.; cliffs near Laguna. W.M.P. Pl. VI. Fig. 36.

*Hirundo erythrogaster* Bodd. Barn Swallow. Seen. H.W. Migration records for Chino, Corona, Laguna. W.M.P. Pl. VI. Fig. 38.

*Iridoprocne bicolor* Vieil. Tree Swallow. H.W. Breeds near Corona; seen in winter in same locality less commonly. W.M.P. Pl. VI. Fig. 39.

*Tachycineta thalassina lepida* Mearns. Northern Violet-green Swallow. H.W. Claremont. Metz. Breeds in San Antonio Canyon.

*Riparia riparia* Linn. Bank Swallow. Nesting record for Newport, June, 1916. Migration record near Corona in spring. W.M.P. Pl. VI. Fig. 37.

*Stelgidopteryx serripennis*. Audub. Rough-winged Swallow. Pl. VI. Fig. 40.

*Bombycilla cedrorum* Vieill. Cedar Waxwing. H.W. Claremont. L.L.G. Very abundant in fall, winter and spring, Claremont, Ontario, Pomona, San Antonio, San Dimas. W.M.P. Pl. VII. Fig. 1.

*Phainopepla nitens* Swain. Phainopepla. H.W. Claremont. Metz. Breeding records Claremont; winters regularly near Corona in river bottoms. Some winters seen in Claremont. W.M.P. Pl. VII. Fig. 2.

*Lanius ludovicianus gambeli* Ridg. California Shrike. H.W. Laguna. L.L.G. Resident. Breeds Corona, Chino, Ontario; common at Claremont. W.M.P. Pl. VII. Fig. 3.

*Vireosylva gilva swainsoni*, Baird. Western Warbling Vireo. H.W. Abundant in summer in canyons. Breeds. W.M.P. Pl. VII. Fig. 4.

*Lanivireo solitarius cassini* Xant. Cassin Vireo. H.W. San Antonio, Glenn Ranch. W.M.P. Pl. VII. Fig. 6.

*Vireo huttoni huttoni* Cass. Hutton Vireo. H.W. Claremont, San Antonio Canyon. Nests. Resident. W.M.P. Pl. VII. Fig. 5.

*Vireo belli pusillus* Coues. California Least Vireo. H.W. Laguna. L.L.G. Fairly common Glenn Ranch and near Corona. Breeding notes. W.M.P.

*Vireo vicinior* Coues. Gray Vireo. Capistrano. H.H.N. Several seen in Cajon Pass, elevation 3,700 feet. W.M.P.

*Vermivora ruficapilla gutturalis* Ridg. Calaveras Warbler. H.W. Migrates. Glenn Ranch, San Gabriel Canyon. W.M.P.

*Vermivora celata lutescens* Ridg. Lutescent Warbler. H.W. Glenn Ranch, San Gabriel Canyon, San Antonio and San Dimas Canyons. W.M.P. Pl. VII. Fig. 7. Canary yellow.

*Vermivora celata sordida* Towns. Dusky Warbler. San Dimas Canyon. Winter. W. M. P.

*Dendroica aestiva brewsteri* Grinn. California Yellow Warbler. H.W., Metz. Claremont. Breeding near Corona river bottoms. Pl. VII. Fig. 8. Canary-yellow.

*Dendroica auduboni auduboni* Towns. Audubon Warbler. H.W. Claremont. Metz. Abundant in winter in San Antonio Canyon, Claremont, Pomona, Corona. Breeds in higher mountains. W.M.P.

Pl. VII. Fig. 10. Five yellow spots, top of head, throat, under wings, on rump.

*Dendroica nigrescens* Towns. Black-throated Gray Warbler. Seen. H.W. Breeds near Camp Baldy and Cold Brook, San Gabriel Canyon. W.M.P. Claremont during migration. Pl. VII. Fig. 9. Small yellow spot in front of eye.

*Dendroica occidentalis* Towns. Hermit Warbler. H. W. Seen. Migration near Corona, Santa Ana river bottom, upper Lytle Creek. W.M.P. Pl. VII. Fig. 11. Bright yellow on side and top of head.

*Oporornis tolmiei* Towns. Tolmie Warbler. Migration notes from Cold Brook, Glenn Ranch, Claremont, upper Lytle Creek. W.M.P.

*Geothlypis trichas occidentalis* Brew. Western Yellowthroat. H.W. Taken in migration at Claremont. Breeds on river bottoms near Corona, Chino and El Monte. W.M.P. Pl. VII. Fig. 12. Bright yellow throat, back greenish grey.

*Icteria virens longicauda* Lawr. Long-tailed Chat. H.W. Breeds near Corona. W.M.P. Pl. VII. Fig. 13. Bright yellow throat.

*Wilsonia pusilla chryseola* Ridg. Golden Pileolated Warbler. H.W. Migration near Claremont. One breeding record. Santa Ana river bottoms. W.M.P. Pl. VII. Fig. 14. Canary-yellow throat. Back greenish-grey.

*Wilsonia pusilla pileolata* Pall. Alaska Pileolated Warbler. Capistrano. H.H.N.

*Anthus rubescens* Tunst. American Pipit. H.W. Long Beach. Metz. Abundant fall and winter, Corona, Chino, Ontario W.M.P. Pl. VII. Fig. 15.

*Cinclus mexicanus unicolor* Bonap. American Dipper. H. W. Resident San Antonio, San Dimas, Cucamonga, Lytle Creek. W.M.P. Pl. VII. Fig. 16. Female.

*Oreoscoptes montanus* Towns. Sage Thrasher. Taken fall and winter in Corona, near Etiwanda. Seen in early May, upper Cajon Pass. W.M.P. Pl. VII. Fig. 17.

*Mimus Polyglottos leucopterus* Vigors. Western Mockingbird. H.W. Claremont. Metz. Laguna. L.L.G. Breeds in Claremont. W.M.P. Pl. VII. Fig. 18.

*Toxostoma redivivum pasadenense* Grinn. Pasadena Thresher. H.W. Claremont. Metz. Laguna. L.L.G. Breeds at Claremont. W.M.P. Pl. VII. Fig. 19.

*Toxostoma lecontei lecontei* Law. Leconte Thrasher. Seen on Mojave Desert. H.W. Resident, breeding, limited numbers, Mojave Desert. W.M.P.

*Heleodytes brunneicapillus couesi* Sharpe. Northern Cactus Wren. H.W. Claremont. Metz. Common resident, breeding. W.M.P. Pl. VII. Fig. 21.

*Salpinctes obsoletus obsoletus* Say. Rock Wren. H.W. Many records, Claremont, San Antonio Canyon; higher mountains in summer. W.M.P. Pl. VII. Fig. 23.

*Catherpes mexicanus punctulatus* Ridg. Dotted Canyon Wren. H. W. Laguna. L.L.G. Nesting at San Gabriel, Cucamonga. Fairly common. W.M.P. Pl. VII. Fig. 22.

*Thryomanes bewicki charienturus* Oberh. San Diego Wren. H. W. Claremont. Metz. Breeding at Claremont, San Antonio, San Dimas Canyons. W.M. P. Pl. VII. Fig. 20.

*Troglodytes aedon parkmani* Audub. Western House Wren. H.W. Breeding up as far as Camp Baldy. W.M.P. Pl. VII. Fig. 25.

*Telmatodytes palustris paludicola* Baird. Tule Wren. H. W. Abundant and breeding in Santa Ana river bottom. W.M.P. Pl. VII. Fig. 24.

*Nannus hiemalis pacificus* Baird. Western Winter Wren. One record, San Dimas Canyon, Jan. 21, 1915. W.M.P.

*Certhia familiaris zelotes* Osg. Sierra Creeper. Lytle Creek. Glenn Ranch. W.M.P. Pl. VII. Fig. 26.

*Sitta carolinensis aculeata* Cass. Slender-billed Nuthatch. Seen. H.W. Recorded upper Lytle Creek, Glenn Ranch. W.M.P. Pl. VII. Fig. 27.

*Sitta pygmaea pygmaea* Vigors. Pigmy Nuthatch. Upper Lytle Creek. W.M.P. Pl. VII. Fig. 28.

*Baeolophus inornatus inornatus* Gamb. Plain Titmouse. H.W. Oaks near Claremont. W.M.P. Pl. VII. Fig. 29.

*Penthestes gambeli baileyae* Grinn. Baily Chickadee. H.W. Common higher mountains. Sometimes occurs in winter in valleys. Recorded several times from foothills near San Antonio and San Dimas Canyons. Pl. VII. Fig. 34.

*Psaltriparus minimus minimus* Ridg. Coast Bush-tit. H.W. Claremont. Metz. Common, breeding at San Dimas, San Antonio, Claremont. Pl. VII. Fig. 30. May be A.O.U. 743A. W.M.P.

*Chamaea fasciata henshawi* Ridg. Pallid Wren-tit. H.W. Laguna L.L.G. Abundant and breeding Claremont to Laguna, also up in mountains some distance. W.M.P. Pl. VII. Fig. 35.

*Regulus satrapa olivaceus* Baird. Western Golden-crowned Kinglet. Recorded in winter, San Antonio Canyon. W.M.P.

*Regulus calendula cineraceus* Grinn. Western Ruby-crowned Kinglet. H.W. Claremont. Metz. Recorded in winter, San Antonio, San Dimas Canyon, Corona. W.M.P. Pl. VII. Fig. 33. Bright red line on top of head.

*Polioptila caerulea obscura* Ridg. Western Gnatcatcher. H.W. Claremont. Metz. Common and breeding San Antonio Canyon, San Dimas, San Gabriel Canyon, Claremont. W.M.P. Pl. VII. Fig. 32.

*Polioptila californica* Brew. Black-tailed Gnatcatcher. H.W. Claremont. Metz. Many breeding records. Claremont. W.M.P. Pl. VII. Fig. 31.

*Myadestes townsendi* Audub. Townsend Solitaire. H.W. Taken in winter. Fairly common in San Antonio Canyon and San Dimas Canyon. Seen in Claremont in winter. W.M.P. Pl. VII. Fig. 36.

*Hylocichla guttata nanus* Audub. Dwarf Hermit Thrush. H.W. Breeds near Corona, Glenn Ranch. W.M.P. Pl. VII. Fig. 37.

*Hylocichla guttata nanus* Audub. Dwarf Hermit Thrush. H.W. One bird taken in winter near Claremont which Grinnell thinks is this. W.M.P.

*Hylocichla guttata guttata* Pall. Alaska Hermit Thrush. H.W. San Dimas Canyon, Claremont. W.M.P.

*Hylocichla guttata sequoiensis* Baldy. H.W. Sierra Hermit Thrush. Lytle Creek. W.M.P.

*Planesticus migratorius propinquus* Ridg. Western Robin. H.W. Common in winter, Claremont. W.M.P. Pl. VII. Fig. 38.

*Ixoreus naevius meruloides* Gmel. Varied Thrush. H.W. Winter records, San Dimas Canyon and Claremont. W.M.P. Pl. VII. Fig. 39.

*Sialia mexicana occidentalis* Towns. Western Bluebird. H.W. Claremont. Metz. Breeding record, San Dimas Canyon. Common in winter in valley. Breeds in higher mountains. W.M.P. Pl. VII. Fig. 40. Purple-blue, rufus on wings.

*Sialia currucoides* Bechst. Mountain Bluebird. H.W. Many records for winter, Etiwanda, Corona, Chino, Pomona. W.M.P. Pl. VII. Fig. 41. Light blue, greenish blue on throat.

(Contribution from the Zoological Laboratory of Pomona College)

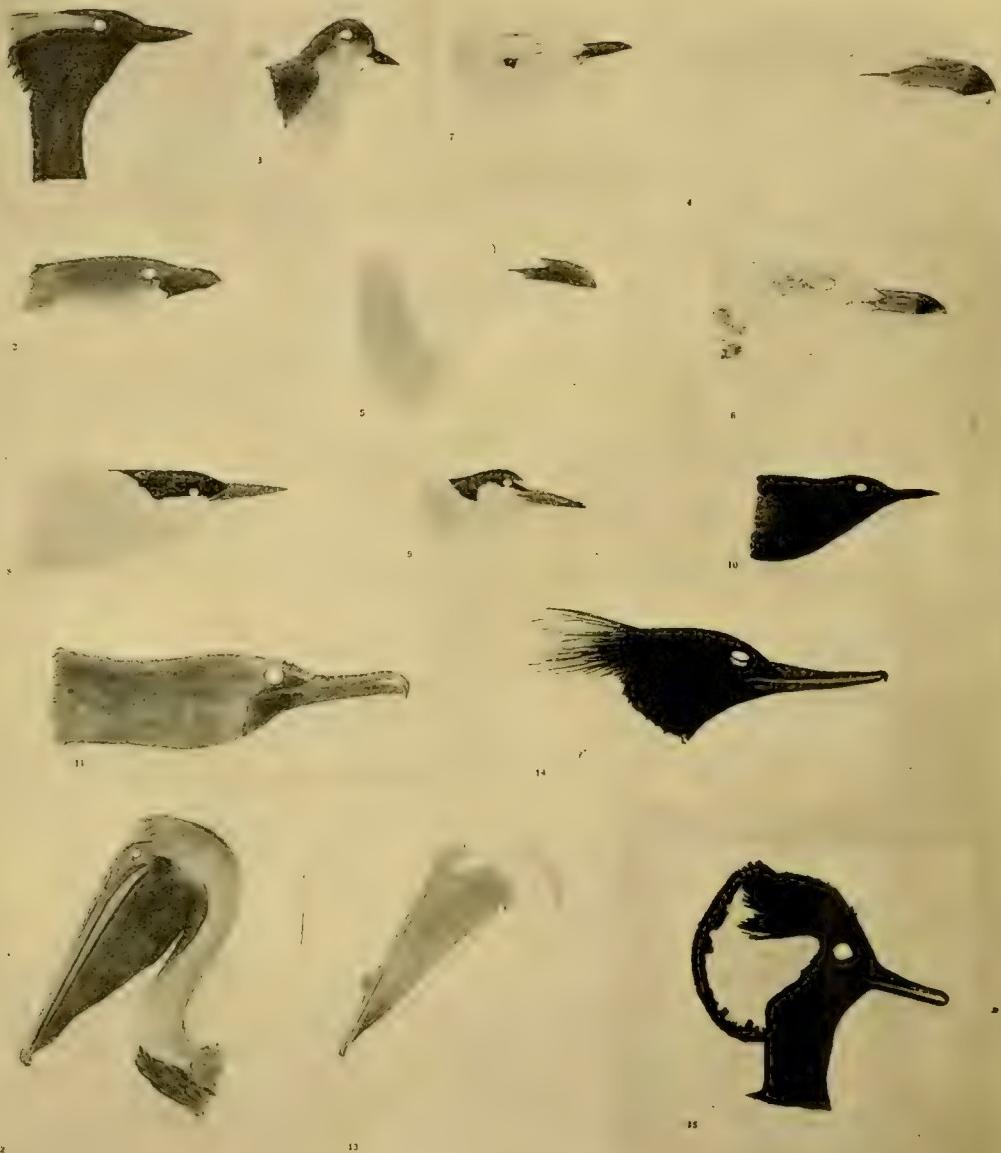


Plate I

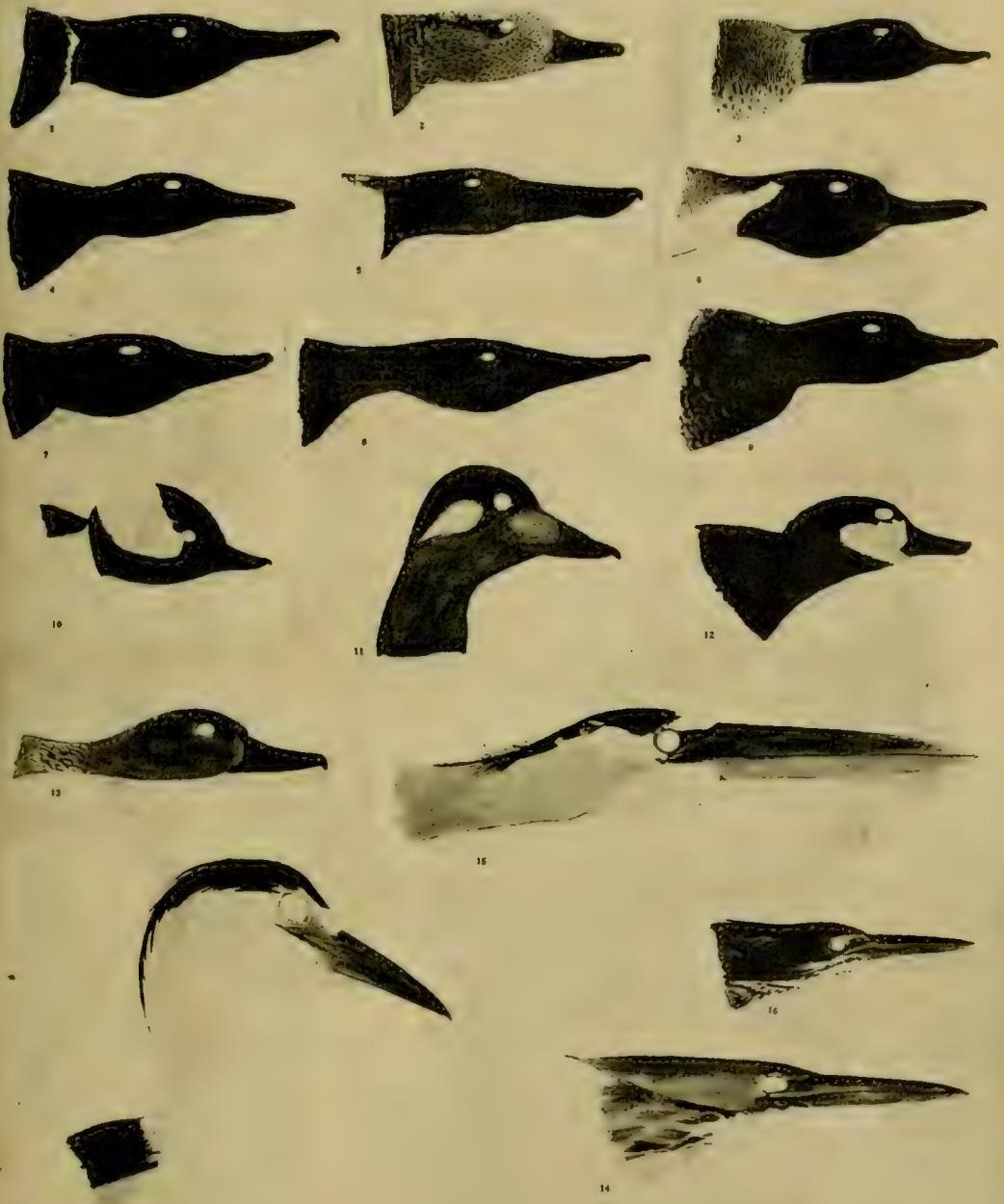


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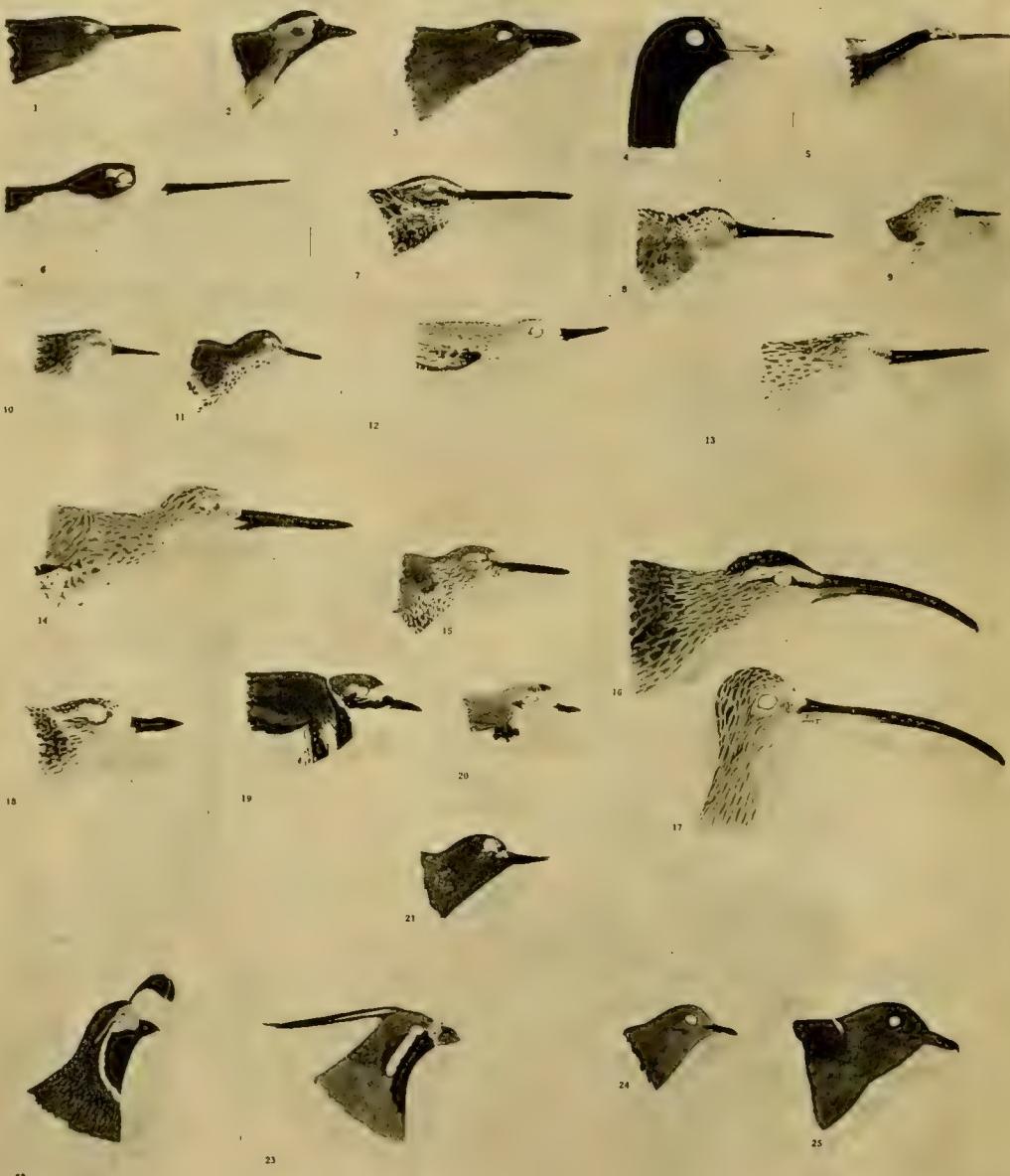


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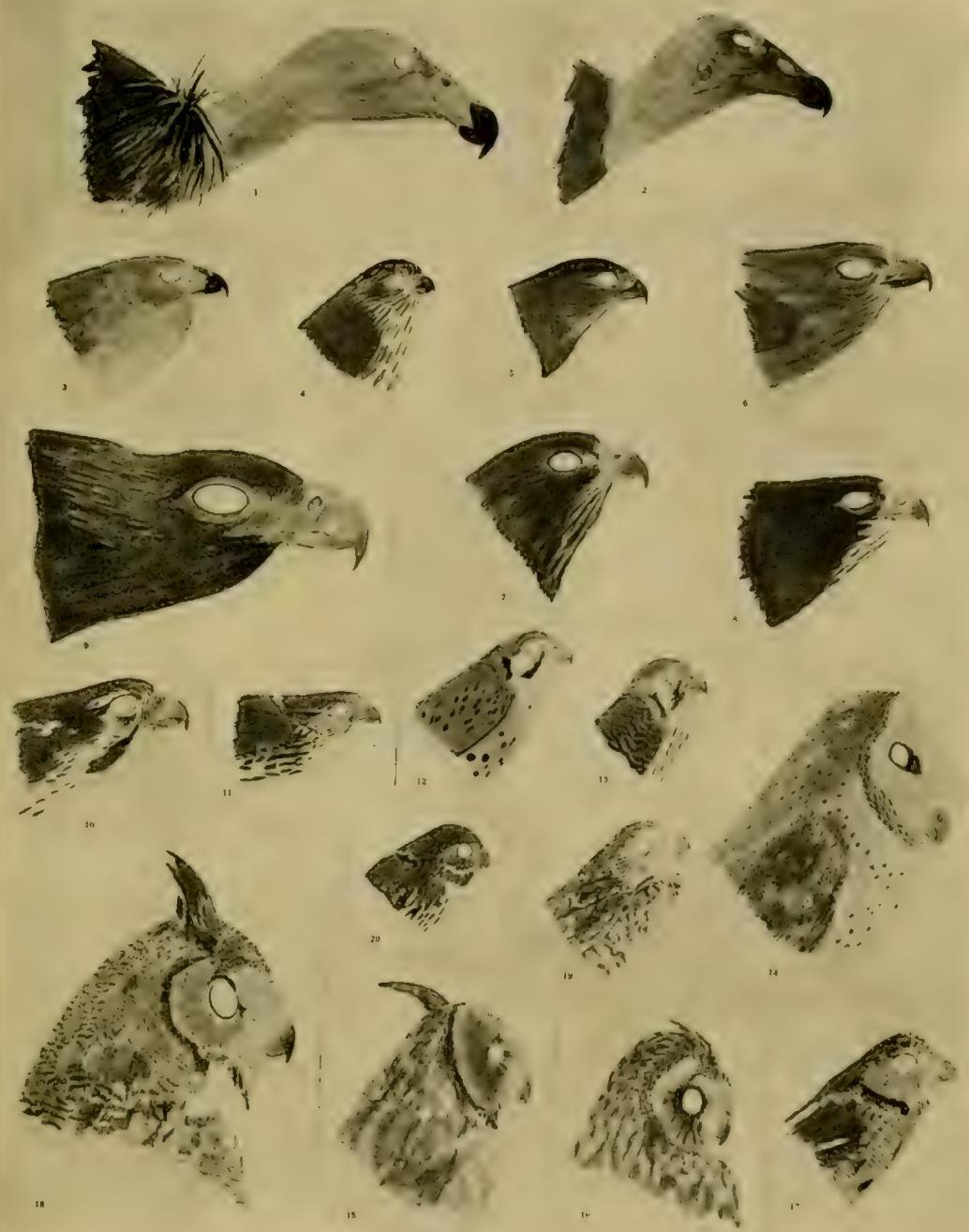


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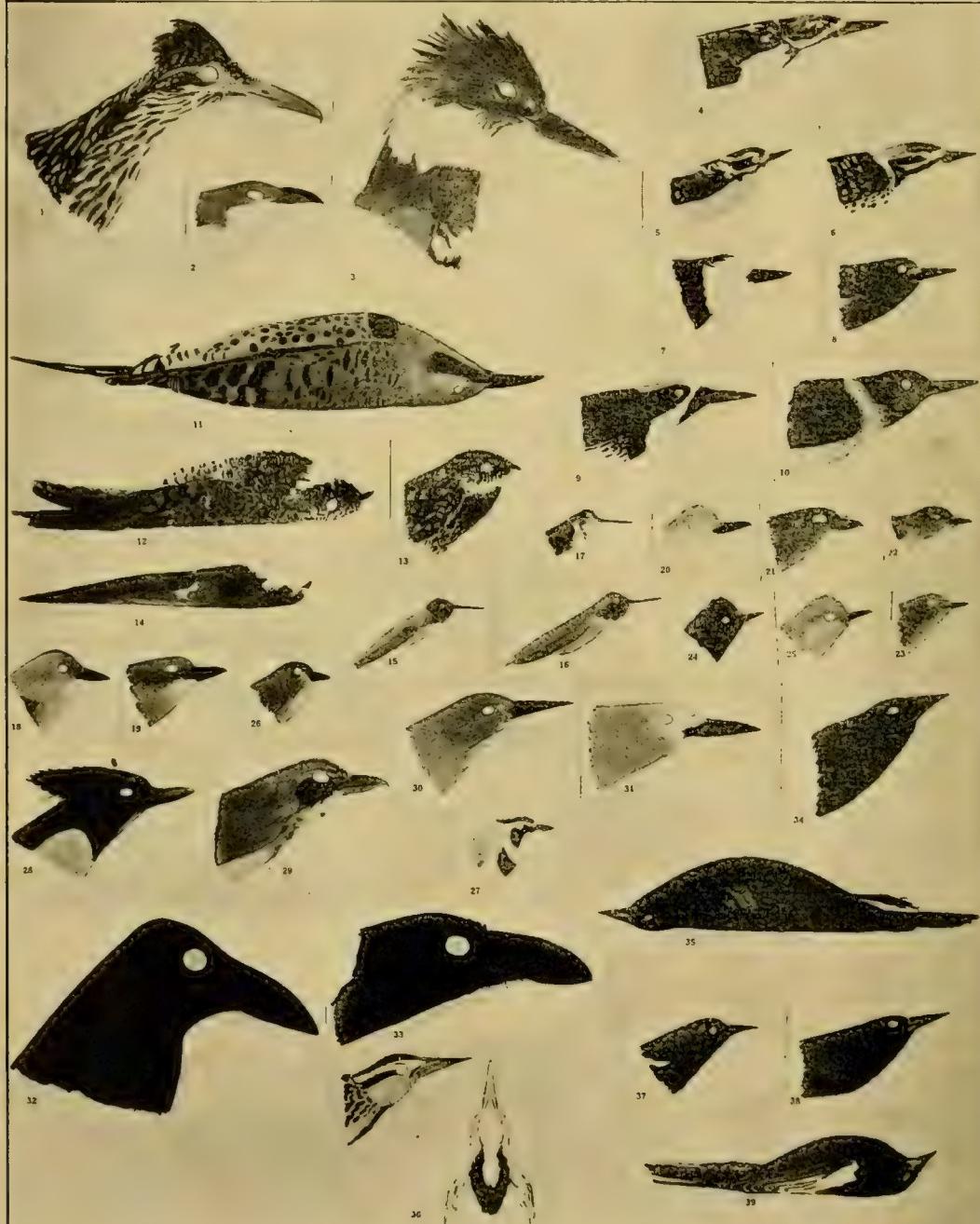


Plate V

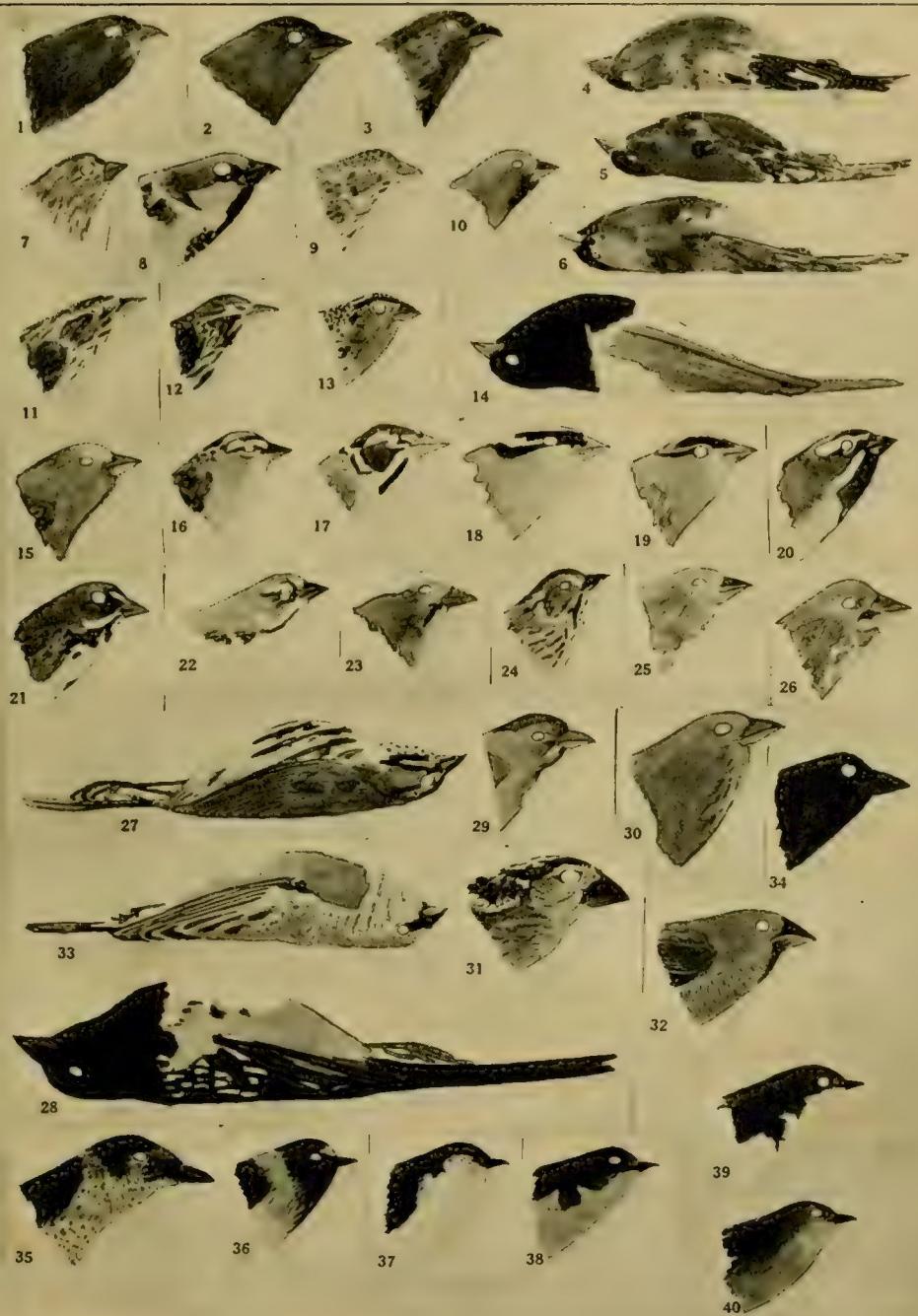


Plate VI

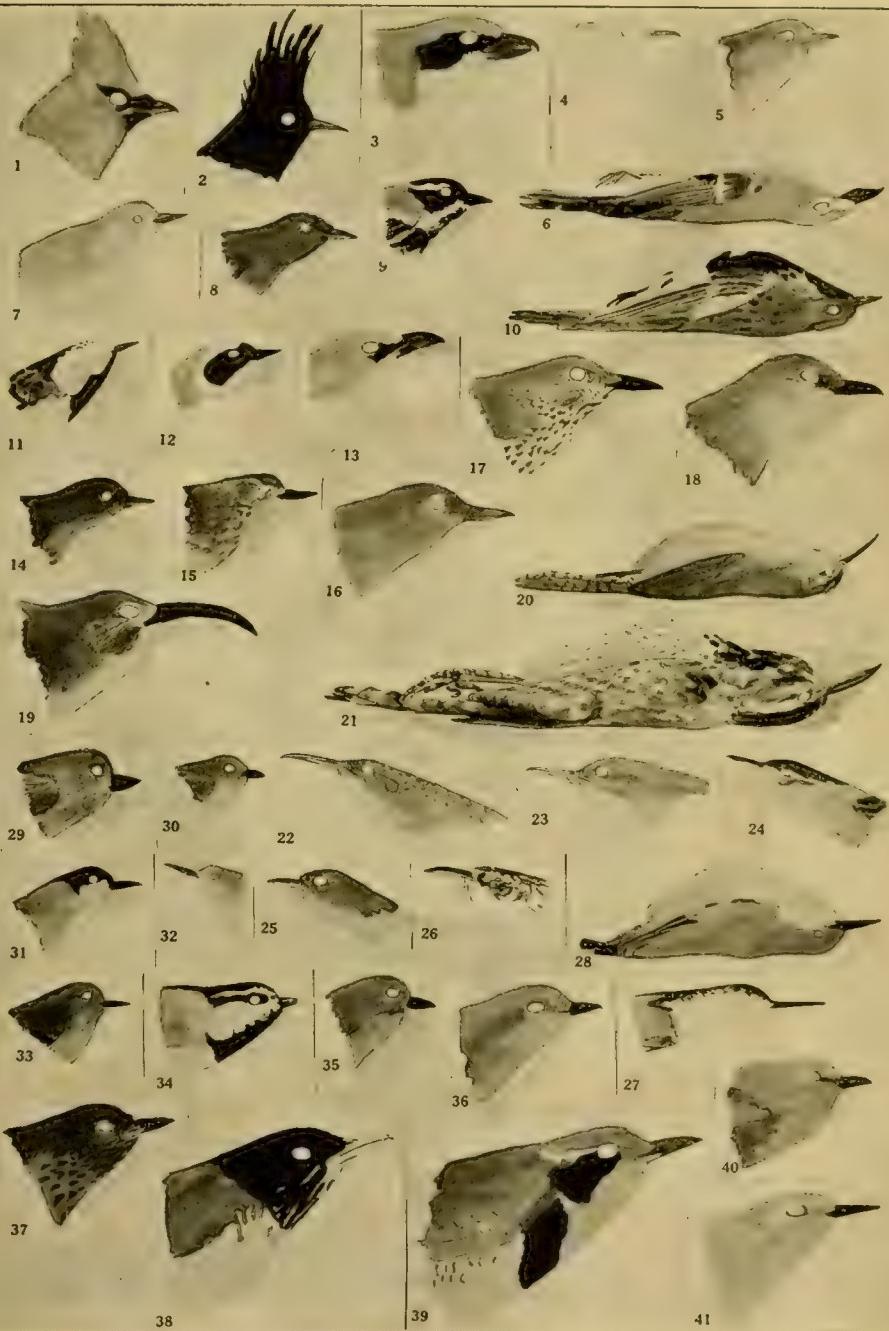


Plate VII

# The Nervous System of *Aracoda Semimaculata* and the Description of a Method of Stereographic Reconstruction

WILLIAM F. HAMILTON

*Aracoda semimaculata*, of the family Lumbriconereidæ (polychætous annelids) is found in great abundance in the mussel beds near Laguna Marine Laboratory. In length the worm may be from five to fifty cm. and in diameter, from two to six mm. In general appearance these worms resemble the earth worm, being without palpi, or tentacles and usually of a reddish brown color. Pigmentation, however, varies from a deep reddish brown to a pale yellow. The cuticle is a tough chitinous membrane clear yellow in cross section, but due to the fact that it is laid on in exceedingly thin laminæ it presents a beautifully iridescent surface.

The prostomium (Fig. 1), is a blunt, ovoid and slightly depressed organ which is practically made up of nervous and sensory tissue, constructed and inter-related in a very complex manner. The peristomium is about as long as the prostomium and twice as long as the body segments (Fig. 3). The body segments are unianulate and very distinct. The parapodia (Fig. 3; a), are biramous, the neuropodium, typically—in the middle segments of the worm—being distinctly longer than the notopodium and bent up finger-like at the tip. The notopodium appears as a broadly rounded discontinuation of the upper half of the body of the parapodium. It is equipped with a varying number of winged pointed setæ and blunt uncinate setæ. The front and hind parapodia become less and less typical as the ends of the worm are approached.

## METHODS

*Fixation.* A large number of the worms, fixed in acetic sublimate and in hot mercuric chlorid were prepared during the summer at the Laguna Marine Laboratory, transferred to 80 per cent alcohol and saved for study the following winter in Claremont. Those fixed in the acetic mixture could easily be sectioned whole in

paraffin of a melting point of 60-62 degrees, but it was necessary to peel off the cuticle and withdraw the setæ of those fixed in hot mercuric chlorid. The internal connective tissues, however, were better preserved in this fluid. There seemed to be no marked difference in fixation of the other tissues.

*Staining.* The most effective stain for tracing out gross anatomy and nerve distribution proved to be a faintly acidified borax carmine used after a fixation of hot mercuric chlorid. The muscular and epithelial tissues were stained a uniform light pink, the nervous tissues a darker pink and the connective tissues, especially the perineurium a bright red. Villain's copper hematoxylin, iron hematoxylin, and double stains of these and methylin blue with eosin, "licht grün" and neutral red were of value for cellular detail.

*Reconstruction Method.* A wax and blotting paper model of the brain (Fig. 2), was made in the usual way. To supplement this two stereographic reconstructions (Figs. 1, 4) were made which were of advantage over the wax model in the following ways. They are easier to make, eliminating the steps that involve cutting out, impregnating and reassembling the parts of the wax reconstruction. It is possible as was done in Fig. 1 to make a "sciagraphic reconstruction" that will show the internal parts in their normal relation to the other organs. If necessary, colors could be used to make the morphological differentiation clearer. When the reconstruction is finished it is the reproduction at a certain magnification of any desired aspect of the object and is equal in all important respects and superior in many respects to a photograph or drawing of a wax reconstruction. What little distortion there is may be calculated as a function of the displacement angle and easily taken into account.

The method pursued may be described as follows: The object should be embedded with a piece of liver or similar tissue having a smooth and quite rectangular face parallel to the axis of the specimen. The pieces may be arranged on a watch crystal after infiltration and the embedding paraffin poured on hot enough not to form a crystallization capsule around them. This gives an orientation guide whose projection is represented in b (Fig. 14). Fig. 14 is a

diagrammatic illustration of the reconstruction of one cylinder inside another by means of this method.

The sections are cut at right angles to the orientation plane and hence transversely to the axis of the object. The knife must be sharp and care must be taken in the mounting to prevent any warping or wrinkling of the sections. An outline of the first section is drawn by means of a projection lantern—represented by the shaded circles (Fig. 14; a)—and a line drawn on the projection of the edge of the section of the liver-piece, represented by the first cross line on b (Fig. 14). From the ends of this cross line are drawn lines in that direction from the cross line that is related to the cross line in the same way as the side of the drawing, which is a projection of part of the aspect to be reconstructed, is related to the center of the drawing. These two lines (the long parallel lines, Fig. 14; b), determine the projection of the orientation plane, and on them are measured off segments about equal to half of the product of the thickness of the sections times the magnification in diameters. The projection of the second section of the series is so placed that the projection of the edge of the liver section coincides with a line drawn between the dots marking off the first segment on the lines determining the orientation plane. The section itself is outlined in the same way except that those parts of the second outline which are "covered up" or are within the area bounded by the first outline are left blank, since they represent the parts of the surface which are hidden from view by the outcurving nearer surfaces. The process is repeated progressively along the segments of the displacement lines with all of the rest of the sections. Those lines which form the edges of the completed figure are re-enforced and then transferred to a separate sheet of paper. This bare outline is shaded to fill out the contour of which the lines on the other sheet are a topographic diagram as shown (Fig. 14c).

It is obvious that the cylinder is somewhat distorted since the face of the figure seen from this point of view should be an ellipse. The distortion is known as a sheering distortion, but as it is constant and does not appreciably alter the relations of the parts the distorted reconstruction is quite as useful as the normal one.

The distortion may be eliminated in either of two ways. The first and best is to set the orientation guide at an angle of about 45 degrees from the axis of the object and cut the sections at right angles to the orientation guide and hence obliquely to the specimen. The reconstruction lines are drawn in the same way except that the projection of the orientation line is allowed to fall in the same place each time, thus eliminating the displacement and consequent distortion. It is hard, however, to get a clear idea of the relations of parts from oblique sections. The reconstruction does not show any more than one that follows the first method, and each series is good for reconstructing only one aspect.

The other way of getting rid of the distortion is to insert at the place of proper magnification in the cone of light rays from the projector a lens of sufficient curvature to refract the rays into a parallel bundle. By tilting the drawing board at a proper angle to this bundle the field will be caused to fall in such an ellipse as to eliminate any distortion. This angle is one whose tangent equals the displacement divided by the product of the thickness of the section times the magnification in diameters.

Occasionally wrinkling of the section in cutting or in mounting occurs and renders it necessary to disregard the orientation guide. It is easy, however to put the section in approximately its right place and to check it up by the next section. In reconstructing symmetrical specimens where there is a clearly marked axial line it is often possible to dispense with the orientation guide and to place the successive sections from landmarks which they themselves bear.

### ANATOMY

The brain (Fig. 1, 2, 4) is a very complex structure. Topographically it is divided into two parts, the dorsal and ventral by the central mass of muscle and blood vessels (Figs. 5, 6, 7; q), which tissue, going forward from between the central part of the brain and the visceral ganglion, pinches out into a muscular sheet at either side and separates the six dorsal lobes from the eight to ten ventral lobes or branches of the fore part of the brain. The brain is symmetrical and is divided into lateral halves by a septum which continues as a canal through the main brain (Fig. 6; w).

Along slightly different lines the brain may be divided into sensory, cross-connective visceral and nuchal parts.

*Sensory System.* The prostomial system of sense organs in this form is one of the most complex and highly specialized among annelids. Just forward of the central cross-connective part (Fig. 6) the brain divides into two lateral halves, which extend down and connect with the two front branches of the visceral ganglion. These halves (Fig. 7), give off two rounded lateral sensory lobes (Figs. 1, 4, 6; b) and then divide into quadrants, the larger of which compose the lower pair. Each of these lower quadrants subdivides into four and sometimes five lobes (Figs. 1, 4, 5; c). The inner three are long and slender, while the outer one, which shows a tendency in large specimens to subdivide at the tip is much shorter and broader. The dorsal pair of quadrants each divide into three distinctly longer and more slender lobes, giving in all from fourteen to sixteen lobes. The lobes are each composed of a cellular and a fibrilar tract. The fiber bundle is on the inside and runs directly back to the main brain, while the cellular area is on the surface side of each lobe and is directly connected with the subcuticular sense organs. These cells (Fig. 12; u), underlie the whole of the prostomial cuticle and are connected with the brain by means of fibers which run into the brain in larger or smaller irregularly placed bundles or even as individual fibers, threaded between the epithelial cells of the subcuticular region. The whole of the prostomial nervous system, including the visceral ganglion and its branches give off sensory fibers in great abundance. In many cases the sense cells seem to send off sensory fibers direct to the cuticle.

In the front lobular region, besides the sense cells and the ordinary small nerve cells (Figs. 5, 6, 7, 10; d), there are a few large cells embedded in the brain (Figs. 5, 10; f). These have nucleoli and in some cases fibers can be traced from them. They are much smaller than the giant cells (Figs. 11, 8; g) in the ventral nerve cord, more irregular, the structure of the protoplasm is much finer and they are much harder to stain with ordinary stains. Hematoxylin leaves them clear unless a mordant is used. Methylen blue and the other common nuclear stains do not touch them. Villain's copper hematoxylin gives the best results, staining the protoplasm

reddish purple and the nucleus blue-black. These cells are found only in the front part of the prostomium. Associated with these in location are a number of mucous cells which have invaded the brain and from their staining reactions seem to be functional (Figs. 5, 10; h).

*Cross-connective part of the brain.* The main part of the brain contains the fibrilar cross-connections for the whole brain. The brain cells are practically all confined to the dorsal side. The eyes, four in number, are buried in this cell layer. The central pair is very small and vestigial, none of the lense structure remaining and but little of the pigment. The lateral pair is complete, with lense and cup-shaped pigment layer, but in all of the specimens I have sectioned the eye is inverted, with the pigment outside and the lense facing down toward the brain. As if to render this ocular paradox more striking the perfect eyes are deeply embedded in the head and the degenerate eyes are just under the cuticle. This is a rather interesting example of degeneration.

From the rear of the brain extend the circumoesophageal commissure and the nuchal ganglia. The former is biramous, dividing on each side into a dorsal and ventral branch. This is analogous to the phenomenon found in *Nephtys* where the ocular and surface-sensory parts of the brain are separate structures. (Quatrefages; 44.)

The nuchal ganglia (Figs. 13, 1, 4; i), are connected to the brain by means of two nerves .3 mm. apart, .03 mm. in diameter and 4 mm. long. These nerves come out from the "punkt-substanz" of the brain immediately below and behind the central pair of eyes, follow along the nuchal pits for some distance, when they join on the two nuchal ganglia on their lower front surface. The nuchal pits act as a pair of narrow-mouthed sacks opening, close together just under the lip of the peristomium, enlarging as they go in until they are large enough to contain in their thin chitino-membranous sack, each, a ganglion. The apparatus bears a rather vague resemblance to the otocyst found in *Arenicola* (Ehlers, '92), but inasmuch as there are no otolyths to be found and the only cavity to contain them is very small and pyramidal instead of round, the diagnosis is doubtful. The thing could hardly be functional, but is probably

degenerate or else for some other purpose. The ganglia are connected by their perineurial sheaths in the mid line and the nuchal sacks, though they do not fuse are separated merely by a thin septum. They differ in this respect from *Lumbriconereis erecta* Moore where the ganglia are quite widely separate. Histologically the structure is much the same as the other ganglia of this form. The cells are a little larger than those of the brain and the reticulum is considerably more noticeable.

The subœsophageal ganglion (Fig. 1; j) is of the usual annelid form as is the nerve trunk (Figs. 8, 9). The segmental nerves are given off one pair to each segment from a long narrow pedicle (Fig. 3; k). They follow around the segment just outside the muscular coat. At the base of the foot there is a small ganglion giving off two branches, one to the foot, which branches twice and one passing beyond the foot to the dorsum where it branches extensively in both the epithelium and muscles.

*Visceral System.* The visceral nervous system (Fig. 4), consists of three visceral ganglia, and a complex system of nerves serving the various pharyngeal muscles. The system originates in a main visceral ganglion (Fig. 4; v), which is situated just below the brain and is equipped with four pairs of symmetrical branches. The front pair of nerve trunks are short and rather thick. They lead to the lateral halves of the brain and their fiber masses fuse with the "punkt-substanz" of this part of the brain. The side branches leave the visceral ganglion at about its central and widest part and lead to the base of the œsophageal connectives. Near where these nerves leave the visceral ganglion a pair of small nerves (Fig. 4; r) about .01 mm. in diameter branch off from the ventral side and extend caudad for a distance of about 2.5 mm. These nerves form an analogue of the complex labio-visceral nervous system found in Eunice. (Quatrefages; '44.) The two hind trunks branch out into the visceral nervous system proper, as diagrammed (Fig. 4). They go straight back, parallel, assuming a diameter of about .04 mm. About 1 mm. behind the visceral ganglion they branch into an outer (Fig. 4; m) and an inner pair (Fig. 4; u).

The outer pair form the maxillary nervous system. They bend ventrad and branch in a very complex manner on either side of the

denticular pouch, serving the complicated musculature of the four pairs of maxillæ.

The inner pair of visceral nerves form the superpharyngeal nervous system. Near where they branch off from the outer pair they partly anastomose, interchanging a few fibers, but with no attendant ganglionic structure. The anastomosis continues for a distance of .16 mm. and then the nerves separate, assuming a diameter of .02 mm. and run parallel about 2 mm. apart for a distance of 1.3 mm. As they do this they bend dorsally so that they are deeply embedded in the upper wall of the denticular pouch and are quite dorsad of the maxillary musculature. This brings them to where the intestine folds off from the dorsal side of the denticular pouch. The nerves bend still more dorsad and become embedded in the intestinal epithelium. Here they become enlarged by ganglion cells and separating (Fig. 4; p), go around the mouth of the intestine proper and come together in the ventral wall of this structure. Just before their second anastomosis they send off two branches into the lateral and dorsal walls of the intestine. These nerves and the one into which the main pair fuses extend back along the intestinal wall for a short distance.

An interesting observation was made on the muscle which acts on the mandibles. It is a long spindle-shaped muscle reaching from the back of the pharynx to the mandibles. These bifurcate black chitinous plates are in apposition to the slit (Fig. 4; 6), whose walls are armed with the maxillæ and form the denticular pouch. The mandibles are bound to the walls of this slit by small muscles used in prehension. Now the members of this group that has the denticular pouch do not completely evert their pharynx in the act of prehension. They merely, from what observations I have been able to make on the Eunicidae and on this form, push out the mandibles and the forceps jaw of the maxillæ. There is no proboscoideal musculature, such as is found in *Phyllodoce*, *Glycera* and *Nereis*, which functions from the inside and by contracting, turns the proboscis inside out. To take the place of the muscles which evert the proboscis by contracting and pulling it out we have in this form a muscle which, acting on the mandible forces this and the forceps teeth of the maxillæ out and does so, paradoxical as it may seem by

*expanding.* The fibers in this muscle, instead of running from the origin to the insertion of the muscle as a whole run dorsoventrally from wall to wall so that any stimulus acting on the nerve which supplies this muscle and causing the fibers to contract would cause the muscle to become rigid, of less diameter and of greater length. Since the origin of the muscle is in the back part of the pharynx and since this organ is bound to the body wall by connective tissue and muscles, the "expansion" of the mandibular muscle must force the mandible forward and with it the forceps teeth of the maxillæ, which are closely bound to it. This action extrudes the teeth and a secondary reflex seems to be established that causes them to be snapped together forcibly soon after they are extruded. This reaction is carried on with such vigor that I have known eunicids to bite themselves into two or three pieces while dying in fixatives.

The advantage of this extrusion system over the more primitive proboscoideal eversion found in the forms without the denticular pouch can be seen in the quickness of the reaction, its superior vigor and the fact that the teeth are extruded first rather than as a final consequence of the comparatively slow eversion of a soft fleshy proboscis.

#### SUMMARY

1. The annelid, *Aracoda semimaculata*, is a highly specialized and evolved member of the lumbriconereidæ, inhabiting the mussel beds near Laguna.
2. Reconstructions were made stereographically as described in this paper.
3. The brain is very complex and highly specialized sensorially. It is divided into the sensory, connective, nuchal and visceral systems, is symmetrical and has a central tubal cavity running through the lower part of the main cross-connective portion of the brain, from front to back, parallel to a cavity which is partly filled with muscles and glands, and runs between the visceral ganglion and the main brain and forward between the dorsal and ventral lobes of the fore brain. This central cavity, taken together with the very complex and convoluted olfactory forebrain presents an appearance which seems quite similar to that described by Patten in *Limulus* and other invertebrates, but which can probably be best explained

as a mere functional adaptation rather than as a phenomenon of phylogenetic importance.

A. The sensory system is composed of the entire surface portion of the brain, i.e., those parts underlying the surface of the prostomium. The forepart of the brain is subdivided into fourteen to sixteen slender lobes of sensory cellular and inside fibrilar tracts. The sensory cellular tracts are not confined to the lobes in front, but extend all over the brain and give off fibers which connect with the subcuticular sense cells or go directly to the cuticle as sense fibers.

B. The main or cross-connective part of the brain consists principally of "punkt-substanz" with dorsal sense cells.

C. Eyes are four in number, the central pair being degenerate close to the surface of the prostomium, and lacking in lense structure. The lateral pair are well-developed but buried deeply in the prostomium and so inverted that the lens is inside and the pigment outside. Neither pair of eyes can be regarded as functional in the adult.

D. The circum-oesophageal connectives branch on each side into a dorsal and ventral ramus. This is analagous to the phenomenon found in *Nephtys* where the ocular and the surface sensory parts of the brain are separate structures.

E. The nuchal ganglia, extending to the rear from the dorsal part of the main brain are connected with a more or less rudimentary organ which is doubtfully a functional otocyst.

F. The suboesophageal ganglion and nerve cord are of the usual annelid form.

G. There is one segmental nerve extending around the body to a small pedal ganglion, whence it branches into two nerves, a pedal and a dorsal. The former gives rise to a motor notopodial branch and a sensory neuropodal branch. The latter is both motor and sensory in its distribution.

H. The visceral system consists of a labial, maxillary and a superpharyngeal system.

(a) The labial system is degenerate from the much more complex system in *Eunice*, or even in the much more closely related *Lumbriconereis*. It consists of a pair of small short nerves running

down the lateral and ventral walls of the œsophagus and originating in the lateral nerves of the visceral ganglion.

(b) The maxillary and superpharyngeal system originate in the main visceral ganglion which is situated just below the brain. The maxillary system branches repeatedly and serves the complex maxillary musculature. The superpharyngeal system goes straight back to where the intestine folds off. Here it develops a pair of slender ganglia which form a nearly complete circumintestinal ring and send off branches to the wall of the intestine.

4. The muscle which causes extrusion of the teeth is attached to the mandibular plates. It is a spindle-shaped muscle but acts by an increase of length instead of a contraction as is usual in muscles of this shape. This expansion is possible through the fact that the muscle fibers run across the muscle instead of from origin to insertion, and from the fact that the whole muscle is enclosed in a thick envelope of tough connective tissue, which holds the muscle rigid when a contraction of the fibers lessen the diameter and increase the length of the muscle. This adaptation seems to render prehension more efficient.

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(Contribution from the Zoological Laboratory of Pomona College)

## EXPLANATION OF FIGURES

- Figure 1. Stereographic reconstruction of the prostomium showing the position of the brain inside of it and the position of the fiber tract inside of the brain. The prostomium is shaded light, the brain darker and the fiber system darkest. The prostomial sensory branches are not shown.  $\times 50$ .
- Figure 2. Photograph of a wax reconstruction of the brain, showing the visceral and nuchal ganglia darkened. The two hundred odd prostomial sensory branches are shown in this reconstruction.  $\times 40$ .
- Figure 3. Diagram of the distribution of a segmental nerve.
- Figure 4. Stereographic reconstruction of the ventral side of the brain and of the visceral nervous system.  $\times 40$ .
- Figure 5. Cross section through the front part of the prostomium cutting through the front lobes of the brain.  $\times 50$ .
- Figure 6. Cross section of the main cross-connective part of the brain showing the eye, the visceral ganglion and the canalicula that runs through this part of the brain.  $\times 50$ .
- Figure 7. Cross section of the brain in front of the main cross-connective part where it has divided into two lateral halves.  $\times 50$ .
- Figure 8. Cross section through the ventral nerve cord near where the segmental nerves come off showing giant cells.  $\times 50$ .
- Figure 9. Cross section of the above between the origins of these nerves.  $\times 50$ .
- Figure 10. Enlarged view of the connection of one of the lobes of the fore brain with the subcuticulum.  $\times 250$ .
- Figure 11. Giant cell and surrounding tissue.  $\times 250$ .
- Figure 12. Subcuticulum showing sense cells, mucous cells and regular subcuticular cells.  $\times 500$ .
- Figure 13. Cross section of nuchal ganglia.  $\times 50$ .
- Figure 14. Diagram of stereographic reconstruction, as described herein of two concentric cylinders; (a) is the first step, showing the cylinders with the topographical reconstruction lines; (b) is the orientation guide, and (c) is the shaded interpretation of (a).

## MEANING OF THE LETTERS

- (a) parapodia, (b) lateral brain lobes (c) frontal brain lobes, (d) brain cells, (e) fiber tracts, (f) large brain cells, (g) giant cells in ventral cord, (h) mucous gland cells, (i) nuchal ganglia, (j) suboesophageal ganglion, (k) pedicle of neurocord, (l) muscle tissue, (m) outer or maxillary nervous system, (n) inner or superpharyngeal nervous system, (o) maxillary slit opening into denticular pouch, (p) ganglia forming circumintestinal ring, (q) cavity which separates the dorsal from the ventral parts of the brain, (r) labial nerves, (s) subcuticular cell, (t) mucous gland cell, (u) sense cell, (v) visceral ganglion, (w) neural canal.

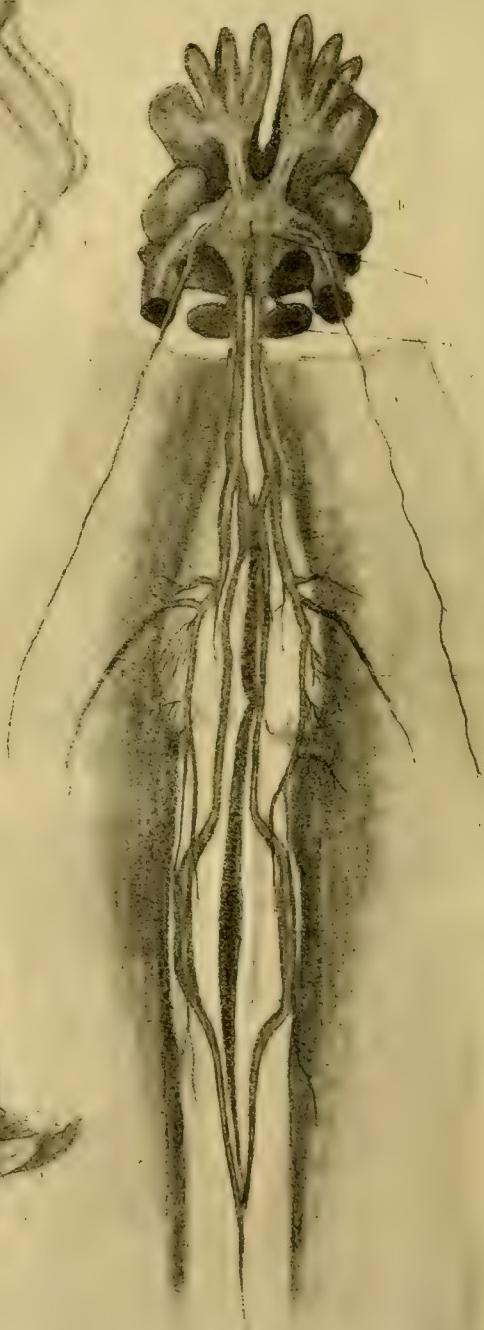
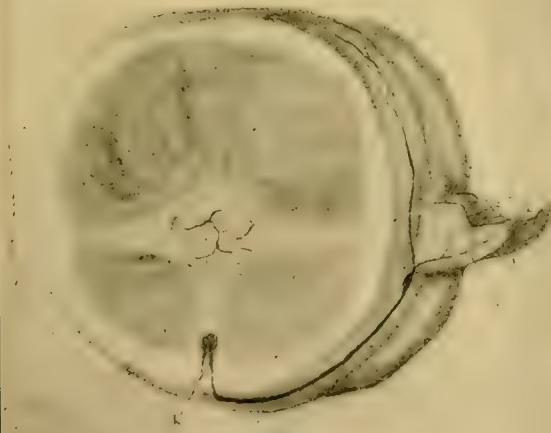
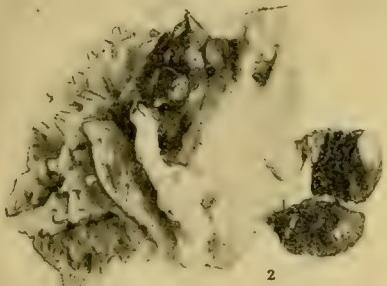
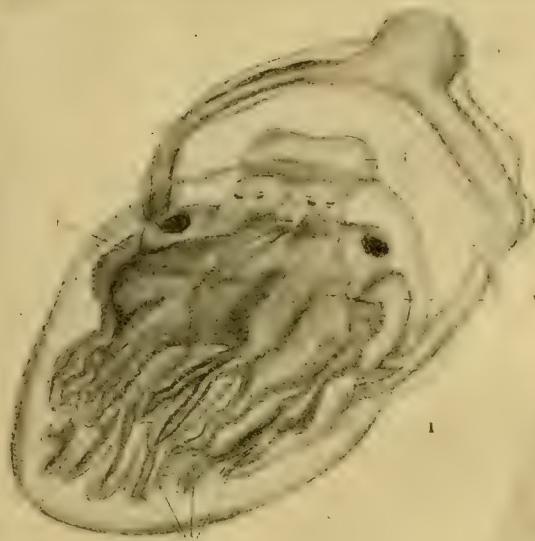
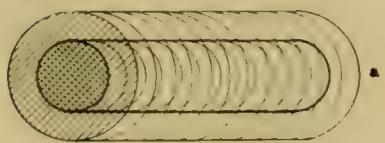


Plate I



b

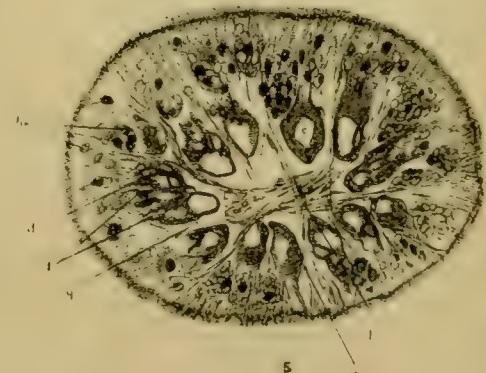
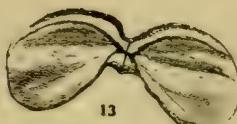
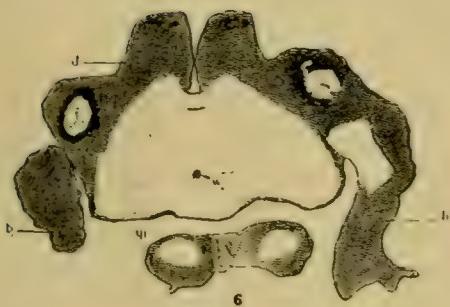
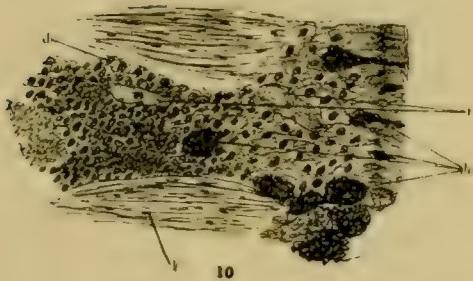
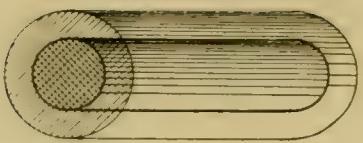


Plate II

# The Central Nervous System of the Amphipod *Orchestia*

WILLIAM A. HILTON

Numerous specimens of *Orchestia traskiana* Stim. were collected at Laguna Beach. Some were preserved whole, from others the central nervous system was studied in position or removed in one piece and stained and sectioned or mounted whole. For whole mounts some carmine stain or a light hermatoxylin coloration seemed best. For sections a copper hematoxylin was used with good results.

The brain occupies the forward portion of the head with large branches or lobes to the compound eyes which are somewhat dorsal and caudal from the brain as it lies in the head. Large nerves to the antennæ and smaller ones to the antennules cannot be seen from above as they run from near the connectives in a more ventral and caudal region. The brain is held in place by a band of tissue which perforates it near the center. In the figure the brain is not shown in the normal position. It is pulled out so as to show its parts better. The connectives join the rather small first ganglion, running almost ventrally when not displaced. Including this ganglion there are eight large thoracic ganglia and four small abdominal centers, the last of which is a little larger than the other three.

In whole mounts the brain does not show well. The ventral ganglia from surface views are found to contain a coating of large and small cells, especially on the ventral sides. Some of these are shown in the figures, which give views of a large and a smaller ganglion at one optical section. There are several layers of cells and both large and small are numerous, the latter of several sizes very numerous. The general position of some of the larger cells is shown in the figures.

In section the brain is found to be chiefly composed of fibers and fibrils. Large strands of fibers run long distances and connect widely separated regions. No very large cells were found in the brain, such as found in the ventral ganglia, and no very marked central region of the brain was clearly seen. The cells as compared with

the fibers were rather few. Fibrils also were evident, but could not be traced far. Cell groups were most marked in the posterior and lateral regions and fibers from these and to these could be followed as individuals for long distances. Posterior cells were especially numerous connected with the eyes and other parts. The ventral ganglia present no unusual structures in section. In two of the upper ganglia studied there seem to be in each at least two masses of cross fibers or communications.

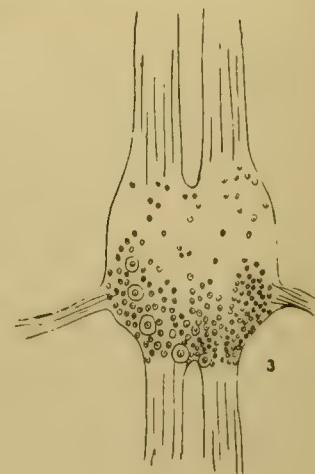
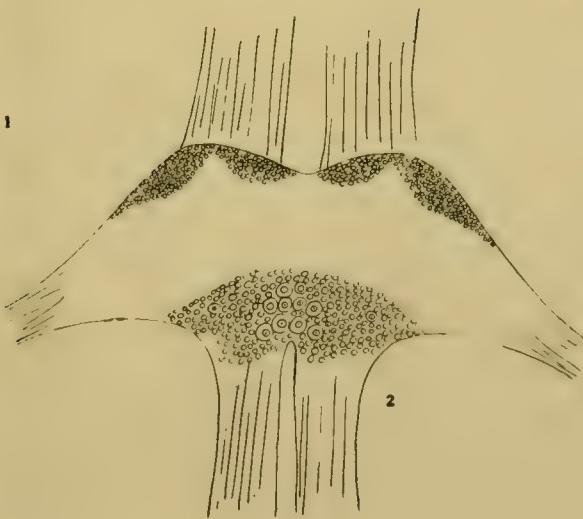
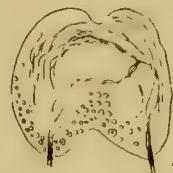
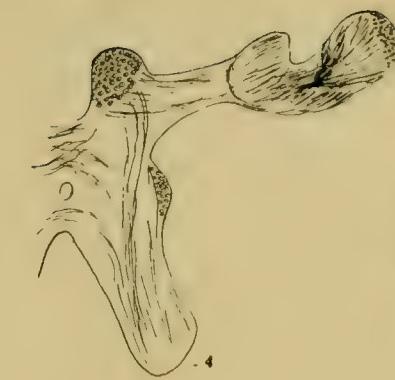
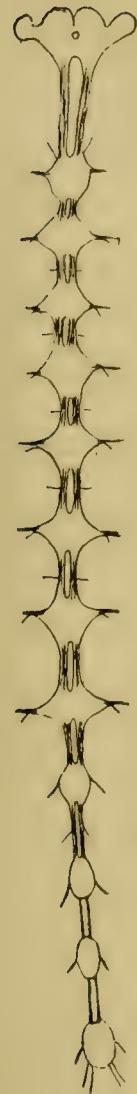
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(*Contribution from the Zoological Laboratory of Pomona College*)

## EXPLANATION OF PLATE

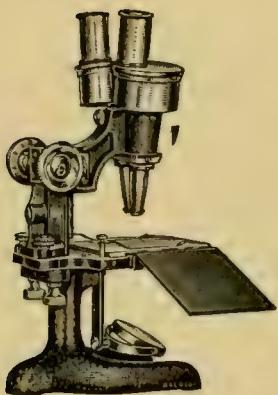
- Figure 1. Central nervous system of *Orchestia*.  $\times 10$ .
- Figure 2. Surface view of one of the thoracic ganglia.  $\times 75$ .
- Figure 3. Surface view of one of the abdominal ganglia.  $\times 75$ .
- Figure 4. Longitudinal section through the brain. Caudal end to the top.  $\times 75$ .
- Figure 5. Longitudinal section of the brain; same as Fig. 4 but deeper.  $\times 75$ .
- Figures 6 and 7. Longitudinal sections of the second ventral ganglion. Caudal end at the top.  $\times 75$ .
- Figure 8. Longitudinal section through the first ventral ganglion. Caudal end at top.  $\times 75$ .



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# List of Bees from Claremont-Laguna Region

HENRY BRAY

Through the kindness of Prof. T. D. A. Cockerell and several others I have been able to get large numbers of our local bees determined. The basis of the work was the extensive Cook-Baker collection of the college with additional material of my own and others. Many of the species here listed have been collected by me and others, but unless not represented in the original college collection it is not noted in the list. So far as the relations of bees to plants has been noted by me it is given in the list. Many other species remain to be determined and only a beginning has been made in respect to the relation of the bees to plants.

## BOMBIDÆ

*Bombus sonorous.* Say. Det. Vier. Claremont, Cal., Baker. April, Fl., Nemophila.

*Bombus californicus.* Sm. Det. Vier. Claremont, Cal., Baker. May, Fl., Phachelia tanacætifolia.

*Bombus crotchii.* Vier. Det. Cr. Claremont, Cal., Baker. May, Fl., Tar weed.

## ANTHOPHORIDÆ

*Anthophora anstrutheri.* Ckll. Det. Ckll. Claremont, Cal., Baker. April, Fl., Lotus glaber.

*Anthophora curta.* Prov. Claremont, Cal., Baker. April, Fl., Lotus glaber.

*Anthophora urbana.* Cr. Claremont, Cal., Baker. April, Fl., Cactus and poppy.

*Anthophora washingtoni.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Anthophora stanfordiana.* Vier. Claremont, Cal., Baker. May, Fl., Amsinckia intermedia.

*Anthophora pacifica.* Vier. Mountains near Claremont, Cal., Baker. April, Fl., Lotus glaber.

*Anthophora simillima.* Cr. Claremont, Cal., Baker. April, Fl., *Lotus glaber*.

*Anthophora edwardsii.* Cr. Det. Ckll. Claremont, Cal., Baker. April, Fl., *Phacelia tanacætifolia*.

*Mellisodes pallidicineta.* Ckll. Det. Br. from Coll. Claremont, Cal., Bray. April, Fl., *Phacelia tanacætifolia*.

*Mellisodes maura.* Cr. Det. Br. from Coll. Claremont, Cal., Bray. May, Fl., *Amsinckia intermedia*.

*Mellisodes pullata.* Cr. Det. Br. from Coll. Claremont, Cal., Bray. April, Fl., *Phacelia tanacætifolia*.

*Mellisodes menuacha.* Cr. Det. Br. from Coll. Claremont, Cal., Bray. May, Fl., *Phacelia tanacætifolia*.

*Mellisodes beltragei.* Cr. Det. Br. from Coll. Claremont, Cal., Bray. Fl., *Amsinckia interm.*

*Synhalonia atrientis.* Smith Det. Br. from Coll. Claremont, Cal., Bray. May, Fl., *Phacelia tanacætifolia*.

*Diadasia crassicauda* sp. n. Ckll. Det. Ckll. Laguna, Cal., R. La Follette.

*Diadasia bituberculata.* Cr. Det. Cr. Claremont, Cal., Baker. April, Fl., *Cactus*.

*Diadasia australis rinconis.* Ckll. Det. Ckll. Claremont, Cal., Baker. May, Fl., *Cactus*.

*Diadasia australis opuntik.* Ckll. Claremont, Cal., Baker. May, Fl., *Cactus*.

## EUCERIDÆ

*Tetralonia actuosa.* Det. Cr. Claremont, Cal., Baker.

*Tetralonia fowleri.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Tetralonia pomona* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Tetralonia robertsoni.* Ckll. Det. Ckll. Claremont, Cal., Baker.

## MELECTIDÆ

*Bombomelecta thoracia.* Cr. Det. Cr. Claremont, Cal., Baker. April, *Nemophila*.

*Pseudomelecta californica miranda.* Fox. Claremont, Cal., Baker.

*Bombomelecta thornica.* Cr. Claremont, Cal., Baker. May, Fl., Nemophila.

*Zacosmia maculata.* Cr. Claremont, Cal., Baker.

*Triepelous ancoratus* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Triepelous callopus.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Bombomelecta maculata.* Vier. Det. Ckll. Claremont, Cal., Baker.

### NOMADIDÆ

*Nomada edwardsii.* Cr. Det. Ckll. Claremont, Cal., Baker. June, no Fl.

*Nomada beulahensis.* Ckll. Det. Br. Claremont, Cal., Bray. From Coll. April, no Fl.

*Nomada americana.* Kby. Det. Br. Claremont, Cal., Bray. From Coll. April, no Fl.

*Nomada crotchii nigrior.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Nomada civilis.* Cr. Det. Ckll. Claremont, Cal., Baker.

*Nomada pyrrha* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Nomada melanosoma,* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Nomada subvicinalis.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Nomada erythrosipa* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Nomada odontocera* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Exomalopsis velutinus.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Exomalopsis melanurus* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Exomalopsis nitens* sp. n. Ckll. Det. Ckll. Laguna, Cal., R. La Follette.

### XYLOCOPIDÆ

*Xylocopa varipuncta.* Patt. Det. Vier. Claremont, Cal., Baker. April, no Fl.

*Xylocopa orsifex.* Sm. Det. Vier. Mountains near Claremont, Cal., Baker. April, Wood.

*Xylocopa californica.* Cr. Det. Friese. Claremont, Cal., Baker. April, Nemophila.

### MEGACHILIDÆ

*Megachile pruina.* Sm. Det. Friese. Claremont, Cal., Bray. May, Fl., Cactus.

*Megachile grindeliarum.* Ckll. Det. Ckll. Claremont, Cal., Bray. May, Fl., Poppy.

*Megachile occidentalis.* Fox. Det. Ckll. Claremont, Cal., Bray.

*Megachile frugalis.* Cr. Det. Ckll. Claremont, Cal., Baker.

*Osmia erythrosmia remotula.* Des. Ckll. Claremont, Cal., Baker.

*Osmia quadriceps.* Ckll. Det. Cr. Mountains near Claremont, Cal., Baker.

*Osmia atrocyanea.* Ckll. Det. Ckll. Claremont, Cal., Baker. May, Fl., Amsinckia intermedia.

*Osmia propinqua.* Cr. Claremont, Cal., Baker.

*Osmia kincaidii.* Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Osmia bennettæ.* Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Osmia integra.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia cobaltina.* Cr. Det. Ckll. Claremont, Cal., Baker. May, Lotus glaber.

*Osmia faceta.* Cr. Det. Ckll. Claremont, Cal., Baker.

*Osmia clarescens.* Ckll. Det. Ckll. Claremont, Cal., Baker. April, Fl., Phacelia tanacætifolia.

*Osmia granulosa.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia regulina.* Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Osmia ednae,* female. Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Osmia playtura.* Ckll. Det. Ckll. cotype. Claremont, Cal., Baker.

*Osmia hypochrysea.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia pumila.* Frieze Det. Cr. Claremont, Cal., Bray. May, Fl. Mustard.

*Osmia cyanopoda* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia cyanosoma.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia nigrobarta* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Hoplitis sambuci.* Titus Det. Ckll. Claremont, Cal. April, Poppy.

*Hoplitina pentamera.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia pogonigera.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Alcidamea hypocrita.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Osmia melanopleura* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Anthidium maculosum.* Cr. Det. Cr. Claremont, Cal., Baker.

*Dianthidium illustri.* Cr. Det. Ckll. Claremont, Cal., Baker.

*Anthidium palliventre.* Cr. Det. Br. from Coll. Claremont, Cal., Baker.

*Anthidium tricuspidum.* Prov. Det. Ckll. Claremont, Cal., Baker.

*Dianthidium consimile.* Ashmead Det. Ckll. Claremont, Cal., Baker.

*Dianthidium robertsoni.* Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Anthidium angelarum.* Titus Det. Ckll. Claremont, Cal., Baker.

*Dianthidium provancheri.* Titus Det. Ckll. Claremont, Cal., Baker.

*Dioxys producta.* Cr. Det. Ducke. Claremont, Cal., Baker.

*Dioxys pomonæ.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Coelioxys megatricha* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Coelioxys angulifera* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Xenoglossa angelica.* Ckll. Det. Ckll. Claremont, Cal., Baker.

#### ANDRENIDÆ

*Andrena porterae.* Vier. Det. Ckll. Claremont, Cal., Baker.

*Andrena mustelicolor.* Vier. Det. Vier. Claremont, Cal., Baker.

*Andrena prunorum.* Vier. Det. Ckll. Claremont, Cal., Baker and Bray. May, Phacelia tana, and Poppy.

*Andrena mimecta.* Ckll. Det. Ckll. Mountains near Claremont, Cal., Baker.

*Andrena texana.* Cr. Det. Br. from Coll. Claremont, Cal., Bray. May, Fl., Poppy.

*Andrena bipunctata.* Lovell Det. Br. from Coll. Claremont, Cal., Bray. April, Fl., Phacelia tan.

*Andrena cerasifolii.* Vier. Det. Ckll. Claremont, Cal., Baker. April, Phacelia tanacetifolia.

*Andrena carlina* Ckll. Ashmead Det. Br. from Coll. Claremont, Cal., Bray. May, Fl., Mustard.

*Andrene osmoides* sp. n. Cr. Det. Ckll. Claremont, Cal., Baker.

*Andrena peratra* sp. n. Prov. Det. Ckll. Claremont, Cal., Baker.

*Andrena auricoma.* Sm. Det. Ckll. Claremont, Cal., Baker.

*Andrena plana.* Vier. Det. Ckll. Claremont, Cal., Baker.

*Andrena opaciventris* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Andrena chlorura* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Agapostemon splendens.* Friese Des. Lange. Los Angeles, Cal.

*Agapostemon californicus.* Crawford. Claremont, Cal., Baker. May, Poppy.

*Agapostemon radiatus.* Say. Det. Br. from Coll. Claremont, Cal., Bray. April, Fl., Daisy.

*Diandrena beatula* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Diandrena chalybæa.* Cr. Det. Ckll. Claremont, Cal., Baker.

*Diandrena cyanosoma* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Diandrena clariventris* sp. n. Ckll. Claremont, Cal., Baker.

*Diandrena scintilla* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Conanthalictus bakeri.* Crawford Det. Ckll. Claremont, Cal., Baker.

*Conanthalictus macrops* sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

*Augochlora pomoniella.* Ckll. Det. Ckll. Claremont, Cal., Baker.

*Andrena candida.* Sm. Det. Ckll. Claremont, Cal., Baker.

*Andrena angustitarsata.* Vier. Det. Vier. Claremont, Cal., Baker.

*Andrena huardi.* Vier. Det. Vier. Claremont, Cal., Baker.

*Andrena pallidifrons.* Vier. Det. Vier. Claremont, Cal., Baker.

*Andrena cyanosoma.* Ckll. Det. Vier. Claremont, Cal., Baker.

*Andrena nigripes.* Prov. Det. Vier. Claremont, Cal., Baker.

*Andrena scripta.* Vier. Det. Vier. Claremont, Cal., Baker.

*Andrena substristis.* Ckll. Det. Vier. Claremont, Cal., Baker.

### CERITINIDÆ

*Ceratina neomexicana punctigena* sub. sp. n. Ckll. Det. Ckll. Claremont, Cal., Baker.

### HALICTIDÆ

*Halictus incompletus.* Craw. Det. Mountains near Claremont, Cal., Baker.

*Halictus punctatoventris.* Craw. Claremont, Cal., Baker.

*Halictus nigrescens.* Craw. Claremont, Cal., Baker.

*Halictus catalinensis.* Craw. Det. Ckll. Claremont, Cal., Baker.

*Halictus ligatus.* Say. Det. Craw. Claremont, Cal., Baker.

*Halictus robustus.* Craw. Det. Claremont, Cal., Baker.

*Halictus mellipes.* Craw. Det. Claremont, Cal., Baker.

*Halictus farinosus.* Sm. Det. Craw. Claremont, Cal., Baker.

*Halictus rhoptoides.* Craw. Det. Br. from Coll. Claremont, Cal., Bray. April, Daisy.

### COLLETIDÆ

*Colletes californicus.* Prov. Claremont, Cal., Baker.

*Colletes guadialis.* Sm. Det. Ckll. Claremont, Cal., Baker.

## PROSOPIDÆ

*Prosopis episcopalis*, female. Ckll. Det. Metz. Claremont, Cal., Baker (*Rhus laurina*).

*Prosopis coloradensis*. Ckll. Det. Metz. Mountains near Claremont, Cal., Baker.

*Prosopis polifolia*, female. Ckll. Det. Metz. Mountains near Claremont, Cal., Baker.

## PANURGIDÆ

*Panurginus atriceps*. Ckll. Det. Cr. Claremont, Cal., Baker.

(Contribution from the Zoological Laboratory of Pomona College)

# A Partial List of the Mammals of the Claremont Region

LEON L. GARDNER

Since little or nothing has been published on mammals of this region it was deemed advisable to print a list even though very incomplete and based on preliminary and limited collecting in order to have some definite forward step in this much neglected line. Some of the mammals listed below have not been collected by us but are known to occur. Thanks are due Mr. H. S. Swaith for his kind aid in identification of some of the skins collected.

Bears of course have long since disappeared but still have left their reputation among old mountaineers. The story goes that a bear, perhaps the last one, was killed at Bear Flats on the trail to "Old Baldy," hence the name.

*Odocoileus hemionus californicus.* (Caton.) California Mule Deer. Fairly common through Upper Sonoran and Transition zones. They have been taken as low as the mouth of San Dimas canyon. The recently established game preserve assures an increase in the future. Already they seem to have sensed the protection for on May 19, 1916, we were surprised to find just 75 feet before us a large doe on the auto road not far above the first power house.

*Ovis canadensis nelsoni?* C. M. Merriam. Merriam Desert Bighorn. Mountain sheep have lived for years in the higher peaks above Claremont but being very shy and in inaccessible and little frequented parts have escaped attention very successfully. Rumor has it that Mountain Goats are found with the sheep but I believe this to be unfounded, having been originated probably by the sight of the smaller horned females and young. The area occupied by the sheep is a very definite one and comprises the peaks Ontario, Cucamonga, Telegraph, St. Antonio ("Old Baldy"), and Iron Mountain with their high rocky intervening ridges. Of the points mentioned the first three peaks are the favored ones. I found only a few tracks on Iron Mountain and a rumor of a pair of horns found there some five or eight years ago. "Old Baldy" being too

often visited is not a frequented spot for the sheep, serving only as a connecting link to Iron Mountain. However signs around Ontario, Cucamonga and Telegraph peaks are abundant and anyone with a little patience and diligent endeavor can readily see the sheep themselves. They travel often in bands, as many as fifty and in summer keep to the highest places. Where they go in winter is as yet a mystery to me, probably lower into canyon heads for I have never found them on the top during this season. This of course is natural for these peaks practically become great ice mountains dangerous for anything to travel over. Besides grass the food consists of twigs and leaves of *Castanopsis sempervirens*, several species of *Ceanothus*, *Rhammus croceus californicus*, *Rhus trilobata* and a parsnip *Pastinaca sativa*.

*Citellus beecheyi*. Richardson. California Ground Squirrel. Abundant in all parts from brush land to 8,000 feet altitude in suitable localities.

*Sciurus griseus anthonyi*. Mearns. Anthony Gray Squirrel. Very common in the transition zone. In early spring they start working on pine cones on the mountain tops, gradually coming down to more abundant supplies of food until fall finds them down in the oak belt feeding on acorns. They winter as low as Palmers canyon in some cases.

*Entamias Sp.* Abundant in the pine belt and as high as the top of "Baldy." They are good climbers, exceedingly active and bursting with curiosity.

*Onychomys torridus ramona*. Rhoads. San Bernardino Grasshopper Mouse. But two specimens of this carnivorous mouse were taken in a period of trapping extending over three months. Both specimens were taken on bait consisting of rolled oats and in the same place, east of Indian Hill in the brush. A good many of my specimens were more or less devoured in the traps in this locality, and I strongly suspect this mouse of the crime. Nowhere else were my mice eaten or were any grasshopper mice taken.

*Peromyscus maniculatus gambeli*. Baird. Gambel Whitefooted Mouse. This species was one of the most common forms taken, being abundant in the brushy valley and foothills. There is a great deal of color variation in the specimens taken.

*Peromyscus boylei rowleyi.* (Allen.) Rowley White-footed Mouse. No specimens were trapped in the valley. However these mice were found not uncommon at the mouth of Palmers canyon, just four miles north of Claremont, in the dry brush land. Within the canyon they were common and were taken as high as the top of Ontario peak along fallen logs. At Camp Baldy they are very common especially along water courses and fallen logs. Indications are that they ignore zonal limits being taken well down in Lower Sonoran zone and in high transition and not necessarily near water.

*Peromyscus californicus insignis.* Rhoads. Chemisal Mouse. Not common. None were taken in the valley and few in the canyons. They were not found along waterways but frequently brushy hillsides. This is a large species of mouse and was almost too much for the little "gee whiz" traps to hold.

*Peromyscus eremicus fraterculus.* Miller. Dulzura Mouse. Common in the brush land of both valley and foothill, being found in the canyons also.

*Reithrodontomys megalotis longicauda.* Baird. Long-tailed Harvest Mouse. Common in valley and foothill. Although partial to grassy areas (I took many in the grassy runways made by meadow mice—*Microtus californicus*). I found them not uncommon in the dry brush land east of Indian Hill.

*Neotoma fuscipes macrotis.* Thomas. Southern Brush Rat. Common from valley to 5,000 feet in the mountains in suitable localities. I took one in the property house at the Greek theatre this June. The large nests are seen very commonly in the canyons and hillsides.

*Neotoma intermedia intermedia.* Rhoads. Intermediate Brush Rat. These seems to be a curious reversal of conditions between this and the former species. Whereas this species is supposed to be taken only up to 3,000 feet, I took none below 3,000, all being taken at 5,000 feet or more along fallen logs near watercourses, and the former species was limited more distinctly to the foothills which is not a typical condition.

*Microtus californicus californicus.* (Peale.) California Meadow Mouse. Common in runways through the grass in damp

canyons, at Palmers canyon and in other suitable localities. One was taken as high as Kelly's cabin—on Ontario peak, among fallen logs by a cold mountain stream. While setting trap in the runways I more than once caught glimpses of them darting along the aisles in the grass.

*Thomomys bottae pallescens*. Rhoads. Southern Pocket Gopher. Abundant in the valley, often doing much damage in lawns and orchards.

*Perodipus agilis agilis*. (Gambel.) Gambel Kangaroo Rats. Abundant from valley to Transition zone. I found them abundant at Brown's Flats where the evidences of their digging and their holes are on every side. I have trapped them in brush country, rocky areas, open brushless places, and at the mouth of ground squirrel holes.

*Lepus californicus*. (Gray.) Jack-Rabbit. Common in the valley and to a certain extent in the foothills and higher.

*Sylvilagus auduboni sanctidiegi*. (Miller.) San Diego Cottontail. Abundant in the Lower Sonoran zone. Increasing each year due to the protection afforded by game laws. Considerable damage to young trees is done by cottontails and they are a great pest to the farmer.

*Sylvilagus bachmani cinerascens*. (Allen.) Ashy Brush Rabbit. Fairly common in the brush. They are not swift runners and rely on escaping by hiding behind clumps of brush. This is more typically an Upper Sonoran form.

*Felis oregonensis oregonensis*. (Rafinesque.) Pacific Congar. Numberless reports are always coming in of Mountain Lions and as usual most of them prove to be unfounded. However authentic records of these beasts are not lacking. I have personally inspected a specimen shot in Cold Water Canyon not more than five years ago. Tradition has it that at one time a mountaineer was actually besieged for two days in the little cabin at Browns Flats. Lions have been seen at Browns Flats, Cattle Canyon and the north of Telegraph peak. Mountaineers tell me that they are a great deal more common in the San Gabriel drainage. The specimen which I saw was from one of the tributary canyons to the San Gabriel river.

*Lynx eremicus californicus.* (Mearns.) California Wild Cat. Common in the mountains and ranging over the valley. About once a year a specimen is brought in to be skinned or identified and great stories are told about them. One of the commonest fallacies is that there are two forms in the mountains, one a "Bob cat" with short tail and ear tufts, and the other a true "Link" or Lynx with longer tail and more prominent ear tufts. It is little wonder, however, that such a notion exists in view of the fact of the great range or variations found in these animals. As for actual records of captures. In the summer of 1911 one was shot in the brushy hill-sides of Laguna Canyon (Orange Co.) and brought in to the Marine Laboratory. In the spring of 1912 a ♀ was shot at the mouth of San Dimas canyon and brought to the college. In December 1914 a ♀ in very worn pelage was shot while crossing the Santa Ana river near Prado Beach and brought to me to be skinned. Finally while trapping for foxes in Palmers canyon in March of 1916 I took a male.

*Canis ochropus ochropus.* (Eschscholtz.) California Coyote. Common in the brush land above Claremont and in the foothills. The yapping bark is a very familiar cry to any who live near the outskirts of the town and may be heard nearly any evening. Although having camped numerous times in the mountains I have never heard Coyotes above the foothill region.

*Urocyon cinereoargenteus californicus.* (Mearns.) California Gray Fox. Signs of foxes in the canyons and along mountain trails are always quite common. Fœces containing seeds of manzanita berries are familiar occurrences. They are fond of fruit and are readily trapped with such bait. In March 1916 three were caught one night at the same place in Live Oak canyon.

*Procyon psora psora.* (Gray.) California Coon. Coons are fairly common in the larger canyons where there is an abundance of water. I have seen their tracks in Palmers, Cucamonga and San Antonio canyons. Three were trapped this winter (1916) just above Camp Baldy at an altitude of about 5400 feet.

*Mephitis occidentalis holzneri.* (Mearns.) Southern California Striped Skunk. Not very common in this region, found mostly in the Upper Sonoran zone in wooded districts.

*Spilogale phenax phenax.* (C. H. Merriam.) California Spotted Skunk. Very common in valley, foothills and up to 6,000 feet in the mountains. They are fearless little creatures and will readily enter cabins in the mountains and keep the occupant awake by rattling pots and pans while scrambling around in search of food, needless to say creating an awkward situation for the host. They have been known to take up their abode underneath houses in Claremont and take the liberty of scampering around the parlor floor without regard to the presence of human beings. This was a common occurrence in a certain family I have in mind and on such occasions the unwelcome guest was gently ushered to the door without hurting its feelings and peace of mind restored to the household. They are the easiest of all animals to trap and made considerable trouble and embarrassment for me by continually blundering into traps of mine set for other game. I have found these little creatures as high as 6,000 feet in the canyons.

*Mustela xanthogenys xanthogenys.* (Gray.) California Weasel. I had always been interested in weasels as to their occurrence and until this year had taken only one in town with a record of only two or three seen along the railroad track. Then in one week four weasels were given me and a record of seven others obtained, all these are from nearby orange groves and from below town along the railroad track where for a long time I have known they occurred.

*Scapanus latimanus occultus.* (Grinnell and Swartz.) Southern California Mole. Moles are occasionally caught in orchards and lawns and the characteristic workings are familiar sights in the mountains up to 8,000 feet. Our specimens were all from the valley.

*Antrozous pallidus pacificus.* (Merriam.) Pacific Pale Bat. I have taken several of these bats from behind pictures and in the attics of some of the college buildings. I do not know their relative abundance or distribution but they are certainly common on the campus in spring and summer.

*Myotis evotis.* (Allen.) Long-eared Bat. This form also occurs in the college buildings and I believe to a certain extent in the mountains.

(Contribution from the Zoological Laboratory of Pomona College)

# A Preliminary List of Shells from Laguna Beach and Nearby

For a number of years past students have collected shells from Laguna Beach, these and the Bradshaw collection form the basis for this list, which includes shells not farther than ten or twelve miles up and down the coast. The earlier collections were by Mabel Guernsey and P. R. Daggs. Practically all the shells drawn and photographed are from the Bradshaw collection because the shells were in better condition. Some of the earlier specimens were determined by the United States National Museum. Suggestions and corrections were kindly made by Mrs. T. S. Oldroyd. The photographs are by Robins and Cooper. Many of the drawings are by Miss Margaret Cate. Doubtful specimens are large omitted in this list, but a few are included and marked by a question.

Plate I, reduced one-half; Plates II and III, natural size; Plate IV,  $\times 10$ ; Plate V,  $\times 6$ .

## BIVALVES

*Yoldia cooperi* Sabb. Fig. 1.

*Mytilus californicus* Conr. Fig. 2.

*M. stearnsii* Pils and Raym. Fig. 3.

*Septifer bifurcatus* Rve. Fig. 4.

*Modiolus modiolus* Linn. Fig. 5.

*M: rectus* Conr. Fig. 6.

*Lithophaga plumula* Hanl. Rock borer. Fig. 7.

*Pectin (Chlamys) monotimeris* Conr. Fig. 8.

*Pectin (Chlamys) aequisulcatus* Cpr. Fig. 9.

*Pectin (Chlamys) pastatus* Sby. Fig. 10.

*Pecten (Hinnites) giganteus* Gray. Fig. 11.

*Lima dehiscens* Conr. Fig. 12.

*Ostrea lurida* Cpr. California oyster. Fig. 13.

*Chama Pellucida* Sby. Fig. 14.

*Phacoides californicus* Conr. Fig. 15.

*Phacoides (Lucina californica) californicus* Conr. Fig. 15.

*Phacoides nuttallii* Conr. Fig. 16.

*Cardium quadrigenarium* Conr. Fig. 17.

- Cardium (Livocardium) substriatum* Conr. Fig. 18.  
*Tivela (Pachydesma) crassatelloides* Conrad. Fig. 19. small specimen.  
*Chione fluctifrage* Sby. Fig. 20.  
*Chione succincta* Val. Fig. 21.  
*Chione undatella* Sby. Fig. 22.  
*Donax laevigata* Desh. Fig. 23.  
*Tagelus californicus* Conr. Fig. 24.  
*Macoma nasuata* Conr. Bent-nosed Macoma. Fig. 25.  
*Macoma indentata* Cpr. Indented Macoma. Fig. 26.  
*Macoma inflatula* Dall. Inflated Macoma. Fig. 27.  
*Samele rupium* Sby. Semele -of-the-Rocks. Fig. 28.  
*Cumingia californica* Conr. California Cuming-shell. Fig. 29.  
*Mya (Cryptomya) californica* Conr. False Mya. Fig. 30.  
*Spisula planulata* Conr. Fig. 31.  
*Spisula falcata* Sld. (?). Falcate Mactra. Fig. 32.  
*Paphia staminea* Conrad. Ribbed Carpet-shell. Fig. 33.  
*Paphia tenessima* Cpr. Finest Carpet-shell. Fig. 34.  
*Parapholas californica* Conr. California Piddock. Fig. 35.  
*Pholadidea penita* Conr. Common Piddock. Fig. 36.  
*Pholadidea subrostrata* Sby. Little Borer. Fig. 37.  
*Milneria minima* Dall. Last Milner-shell. Fig. 38.  
*Aula (Nucula) casternsis* Hinds. Camp Nut-shell. Fig. 39.

#### FRESH-WATER AND LAND SHELLS UNIVALVES

- Physa heterostropha* Say. Laguna stream. Fig. 40.  
*Physa occidentalis* Tryon. Aliso Lake. Fig. 41.  
*Limnophysa palustris* Mull. Fig. 42.  
*Planorbis (Helisoma) trivolvis* Say. Fig. 43.  
*Helix aspera* Mull. Fig. 44.  
*Epiphragmophora* Sp. Fig. 45.

#### MARINE UNIVALVES

- Acmea persona* Esch. Mask Limpet. Fig. 46.  
*Acmea spectrum* Nutt. Ribbed Limpet. Fig. 47.  
*Acmea patina* Esch. Pale Limpet. Fig. 48.  
*Acmea scabra* Roe. Tile Limpet. Fig. 49.

*Acmea incessa* Hds. Seaweed Limpet. Fig. 50.

*Acmea asmi* Midd. Black Limpet. Fig. 51.

*Acmaea (Lottia) gigantea*. Owl Limpet. Fig. 52.

*Acmaea paleacea* Gld. Chalf Limpet. Fig. 53.

*Tylodina fungina* Gab. Fig. 54.

*Gadinia reticulata* Sby. Netted Button-shell. Fig. 55.

*Crucibulum spinosum* Sby. Cup and Saucer Limpet. Fig. 56.

*Crepidula dorsata* Brod. Wrinkled Slipper-shell. Fig. 57.

*Crepidula aculeata* Gmel. Prickly Slipper-shell. Fig. 58.

*Crepidula adunca* Sby. Hooked Slipper-shell. Fig. 59.

*Crepidula nivea* Gould. White Slipper-shell. Fig. 60.

*Crepidula onyx* Sby. Onyx Slipper-shell. Pl. II. Fig. 19.

*Fissurella volcano* Rve. Volcano Shell. Fig. 62.

*Fissuridea aspera* Esch. Rough Key-hole Limpet. Fig. 63.

*Fissuraidea murina* Dall. White Key-hole Limpet. Fig. 64.

*Lucapina crenulata* Sby. Great Key-hole Limpet. Fig. 65.

*Glypidella (Lucapinella) calliomarginata* Cpr. Southern Key-hole Limpet. Fig. 66.

*Megatebennus bimaculatus* Dall. Spotted Key-hole Limpet. Fig. 67.

*Turris (Bathyomma) carpenteriana* Gab. Carpenter Turret Shell. Fig. 68. (Laguna Beach, Jahraus.)

*Trophon belcheri* Hds. Belcher Trophon. Fig. 69. (Jahraus.)

*Trophon triangulatus* Cpr. Three-cornered Trophon. Dredged off Laguna Beach. Bean. Fig. 70.

*Australium undosus* Wood. Wavy Topshell. Fig. 71.

*Bullaria gouldiana* Pisb. Gold's Bubble-shell. Many collected at Balboa much larger than the specimens shown. Fig. 72.

*Haminea vesicula* Gld. White Bubble-shell. Fig. 73.

*Haminea virescens* Sby. Green Bubble-shell. Fig. 74.

*Cypraea spadicea* Gray. Nut-brown Cowry. Fig. 75.

*Trivia californica* Gray. Little Coffee-bean. Fig. 76.

*Trivia solandri* Gray. Solander Trivia. Fig. 77.

*Erato vitellina* Hds. Veally Erato. Fig. 78. (Slightly enlarged.)

*Erato columbella* Mke. Dove Shell. Fig. 79.

*Marginella varia* Sby. Colored Marginella. Fig. 80.

*Marginella jewetti*. California Rice shell. Much like the last but white.

*Olivella biplicata* Sby. Purple Olive Shell. Fig. 81.

*Olivella pedroana* Conr. Pedro Olive Shell. Fig. 82.

*Conus californicus* Hds. California Cone. Fig. 83.

*Macron lividus* A. Ad. Livid Macron. Fig. 84.

*Littorina scutulata* Gld. Checkered Littorine. Fig. 85.

*Littorina planaxis* Nutt. Gray Littorine. Fig. 86. Turned.

*Purpura (Cerostoma) nuttallii* Conr. Nuttall's Hornmouth. Fig. 87.

*Tegula (Chlorostoma) gallina* Fbs. Speckled Turban Shell. Fig. 88.

*Tegula (Chlorostoma) aureotincta* Fbs. Gilded Turban Shell. Large umbilicus with yellow. Fig. 89.

*Omphalus fuscegens* Phil. Banded Turban Shell. Fig. 90.

*Tegula veridula ligulata* Wke. Fig. 91.

*Norrisia norrisii* Sby. Smooth Turban Shell. Fig. 92.

*Thais emarginata* Desh. Rock Purple. Fig. 93.

*Acanthia lapilloides* Conr. Pebbly Unicorn. Fig. 94.

*Acanthia elongata* Conr. Angled Unicorn. Fig. 95.

*Acanthia spirata* Blain. Fig. 96.

*Murex gemma* Sby. Fig. 97.

*Murex (Tritonalia) lurida* Cpr. Lurid. Fig. 98.

*Murex (Tritonalia) gracillima* R. E. C. S. Fig. 99.

*Murex (Tritonalia) circumtexta* R. E. C. S. Fig. 100.

*Murex (Tritonalia) poulsoni* Nutt. Fig. 101.

*Epitonium hindsii* Cpr. White Wentletrap. Fig. 102.

*Epitonium crenatoides* Cpr. Fig. 103.

*Actaeon puncticelatus* Cpr. Barrel Shell. Fig. 104.

*Mitra idæ* Melv. Ida's Miter Shell. Fig. 105.

*Mitra lowei* Dall (?). Fig. 106.

*Alectriion (Nassa) perpinguis* Gld. Fig. 107.

*Arcularia (Nassa) tegula* Reeve. Cover-lip. Fig. 108.

*Turris ophioderma* Dall. Pencilled Drill Shell. Fig. 109.

*Potomides (Cerithidae) californica* Hold. California Horn Shell. Fig. 110.

*Myurella simplex* Cpr. Simple Auger Shell. Fig. 111.

*Amphissa versicolor* Dall. Joseph Coat. Fig. 112. Slightly enlarged.

*Calliostoma canaliculatum* Mart. Channeled Top Shell. Fig. 113.

*Polynices reclusiana* Desh (?). Southern Moon Shell. Fig. 114. under side.

*Amalthea antiquata* Linn. Ancient Hoof Shell. Fig. 115.

*Amalthea tumens* Cpr. Sculptured Hoof Shell. Fig. 116.

*Fossarus fenestratus* Cpr. Windowed Isapis. Fig. 117.

*Lacuna unifasciata* Cpr. One-banded Chink Shell. Fig. 118.

*Melampus olivaceus* Cpr. Olive Ear Shell. Fig. 119.

*Janthina trifida* Nutt. Violet Snail. Shell violet. Jahraus collection. Fig. 120.

*Leptothyra carpenteri* Pilsb. Red Turban Shell. Fig. 121.

*Leptothyra baccula* Cpr. Berry Turban. Fig. 122.

*Calliostoma tricolor* Gabb. Three-colored top shell. Fig. 123.

*Haliotis rufescens* Swains. Red Abalone. Quite common near Laguna.

*Haliotis cracherodii* Leach. Black Abalone. More common than the red.

## TOOTH SHELLS

*Dentalium neohexagnum* S. and P. Hexagonal Tusk Shell. Dredged off Laguna.

## CHITONS

*Mopha hindsii* Sby. Hind's Chinton. Fig. 124.

*Mopha mucosa* Gld. Mossy Chiton. Fig. 125.

*Ischnochiton clathratus* Rve. Fig. 126.

*Ischnochiton magdalensis* Hinds. Gray Chiton. Fig. 127.

*Nuttallina scabra* Rve. Scaly Chiton. Fig. 128.

*Nuttallina californica* Nutt. California Chiton. Fig. 129.

*Trachydermon dentiens* Gld. (Pseudodenturus). Fig. 130.

*Lepidopleurus rugatus* Cpr. Fig. 131.

*Callistochiton crassicostatus* Pilsb. Thick-ribbed Chiton. Fig. 132.

*Tonicella hartwegii* Cpr. Hartweg's Chiton. Fig. 133.

## SMALL SHELLS

Wash Drawings by Miss M. Cate

*Caecum californicum* Dall. Common at Laguna Beach. Pl. IV.  
Fig. 1  $\times 10$ .

*Vitrinella williamsoni* Dall (?). Pl. IV. Fig. 2  $\times 10$ . (This specimen in the Bradshaw collection was so determined, probably at Washington.) Arch Beach, Cal., near Laguna.

*Columbella chrysalloidea* Cpr. Shell white. Pl. IV. Fig. 3  $\times 10$ .

*Columbella pectinifera* Cpr. White shell, cross lines brown. Pl. V. Fig. 1  $\times 6$ .

*Columbella gausapata* Gould. Common Dove-shell. Brown mottled. Pl. V. Fig. 2  $\times 6$ .

*Liotia acuticostata* Cpr. Sharp-ribbed Liotia. Pure white. Pl. V. Fig. 3  $\times 6$ .

*Seila assimilata* Cpr. Dark brown. Pl. V. Fig. 4  $\times 6$ .

*Turbanilla lammata* Cpr. Pl. IV. Fig. 4  $\times 10$ . Light brown. (Dunkeria).

*Tinostoma supravalata* Cpr. (?). Pl. V. Fig. 5  $\times 6$ . Clear white. (Ethalia).

*Callistoma tricolor* Gabb. Pl. V. Fig. 5  $\times 10$ .

*Phasianella pulloides* Gld. Pl. V. Fig. 6  $\times 6$ . Mottled red and white.

*Tritonalia barberensis* Gabb. Pl. V. Fig. 7.

*Leptothyra baccula* Cpr. Pink to gray. Pl. V. Fig. 8  $\times 6$ .

*Leptothyra carpenteriana* Pilsb. Red Turban-shell. Pl. V. Fig. 9  $\times 6$ .

*Leptothyra paucicosta* Dall. White. Pl. V. Fig. 10  $\times 6$ .

*Jeffreysia translucens* Cpr. (?). Pl. V. Fig. 11  $\times 6$ .

*Pedipes unisulcata* J. G. Cooper. Light brown. Pl. V. Fig. 12  $\times 6$ .

*Mitromorpha aspera* Cpr. Brown. Pl. V. Fig. 13  $\times 6$ .

*Vermetus anellum* Morch. White. Pl. IV. Fig. 6  $\times 10$ . This specimen is more coiled than some others.

*Cerithiopus convexa* Cpr. Dark brown. Pl. V. Fig. 14.

*Cerithiopus columnna* Cpr. Light brown. Pl. V. Fig. 15.

- Turritella mesalia lacteola* Cpr. Pure white. (No figure.)
- Bithium aspera* Gabb. Brown. Pl. IV. Fig. 7  $\times 10$ .
- Turbanilla stylina* Cpr. (?). Pl. IV. Fig. 8  $\times 10$ .
- Turbanilla costanea* Cpr. (?). Pl. IV. Fig. 9  $\times 10$ .
- Anachis subturiata* Cpr. (?). Pl. IV. Fig. 10  $\times 10$ .
- Amphissa versicolor* Dall. Pink, white, brown. Pl. V. Fig. 16  $\times 6$ .
- Corbula luteola* Cpr. Small bivalve.
- Philobrya setosa* Cpr. Small bivalve. Pl. V. Fig. 17  $\times 6$ .
- Acila castrensis* Hds. Brownish. Pl. V. Fig. 18  $\times 6$ .
- Carditanera minima* Dall. Brownish-yellow. Pl. IV. Fig. 11  $\times 10$ .
- Crassatella marginata* Cpr. Pl. IV. Fig. 12  $\times 10$ .
- Lasea rubra* Mort. Tinged with red. Pl. V. Fig. 19  $\times 10$ .
- Arca solida* Br. & Sby. (?). Pl. V. Fig. 20  $\times 10$ .

(Contribution from the Zoological Laboratory of Pomona College)

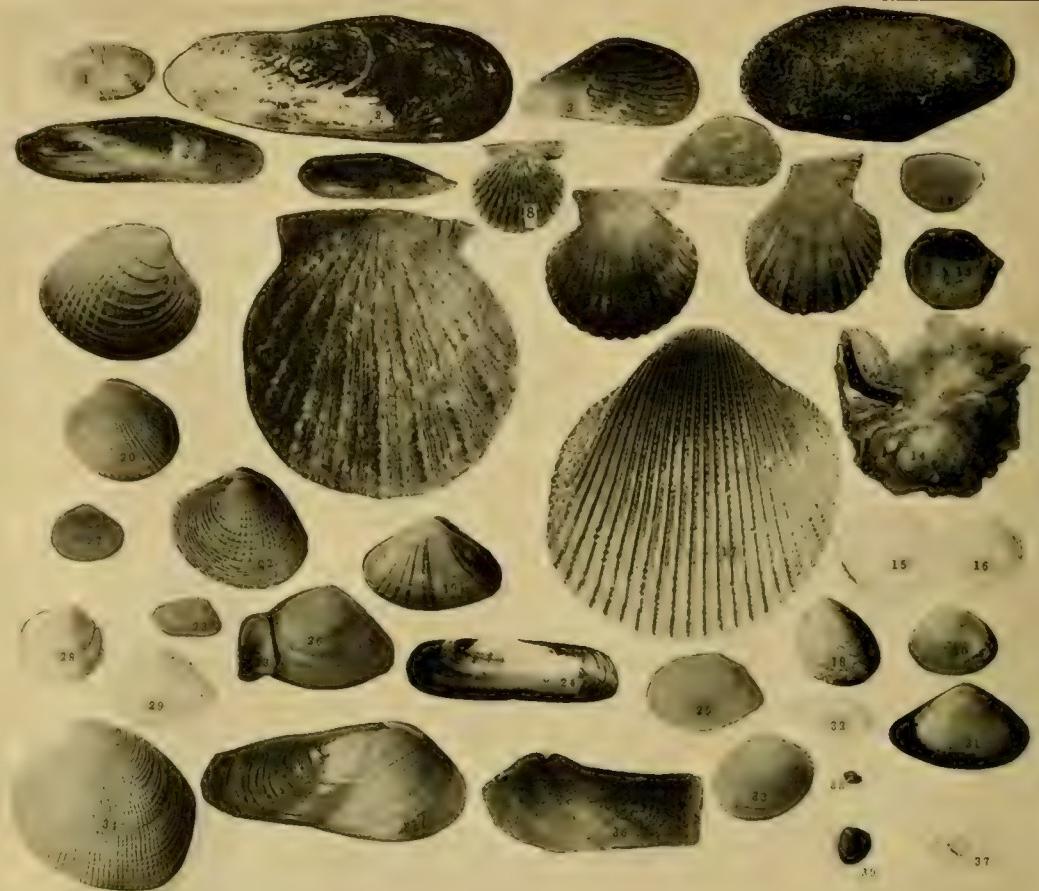


Plate I

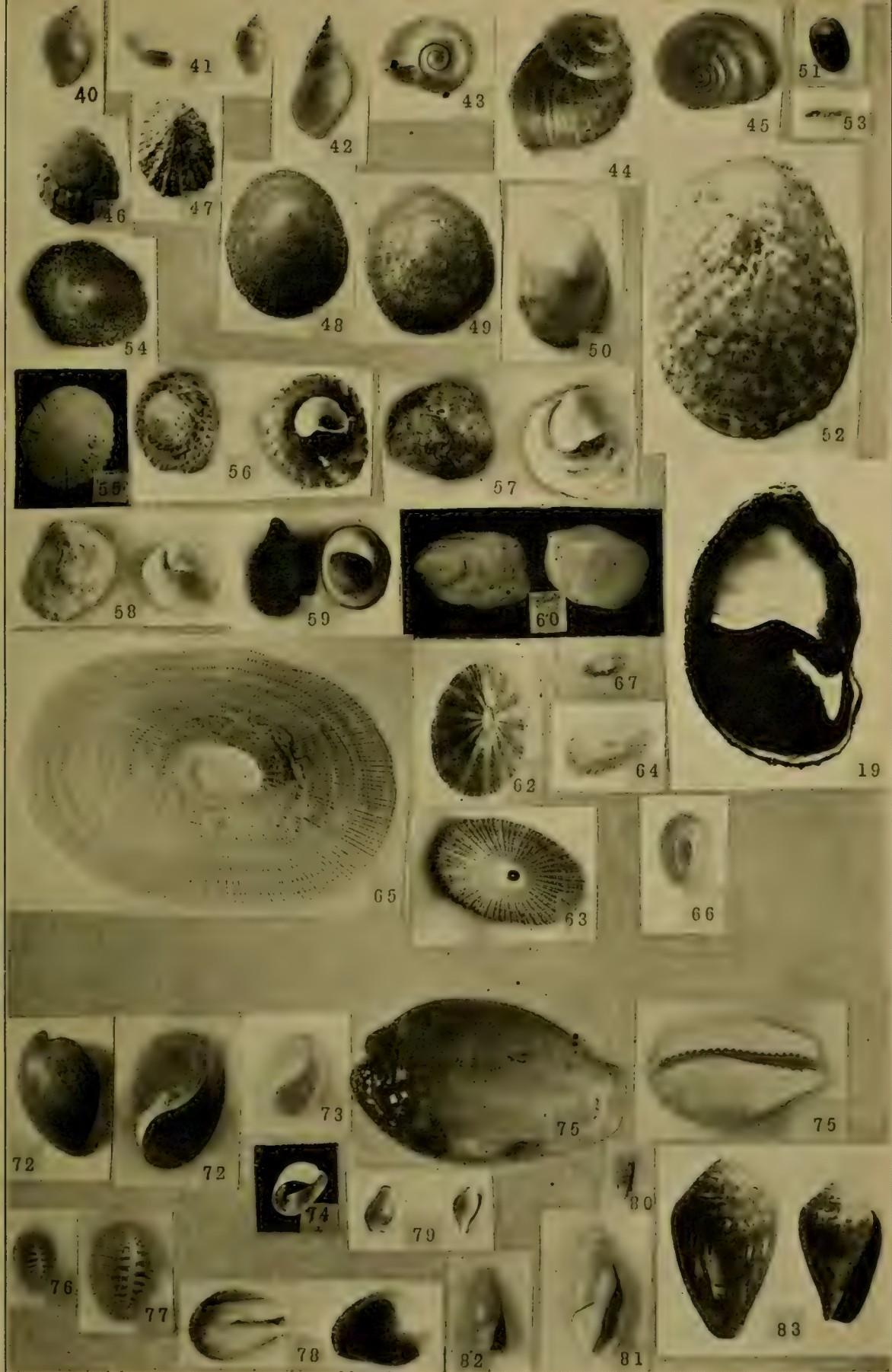


Plate II

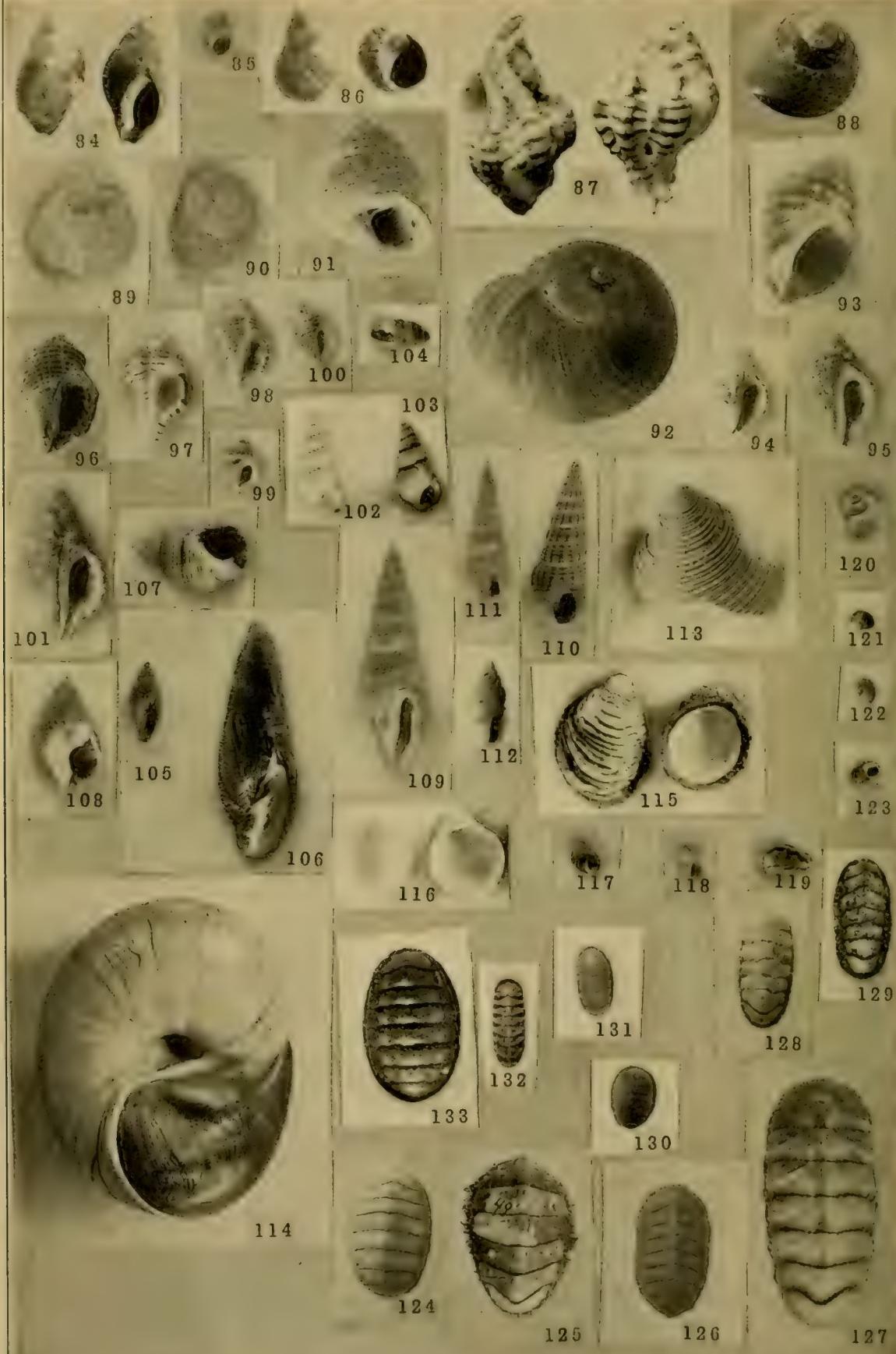


Plate III



Plate IV

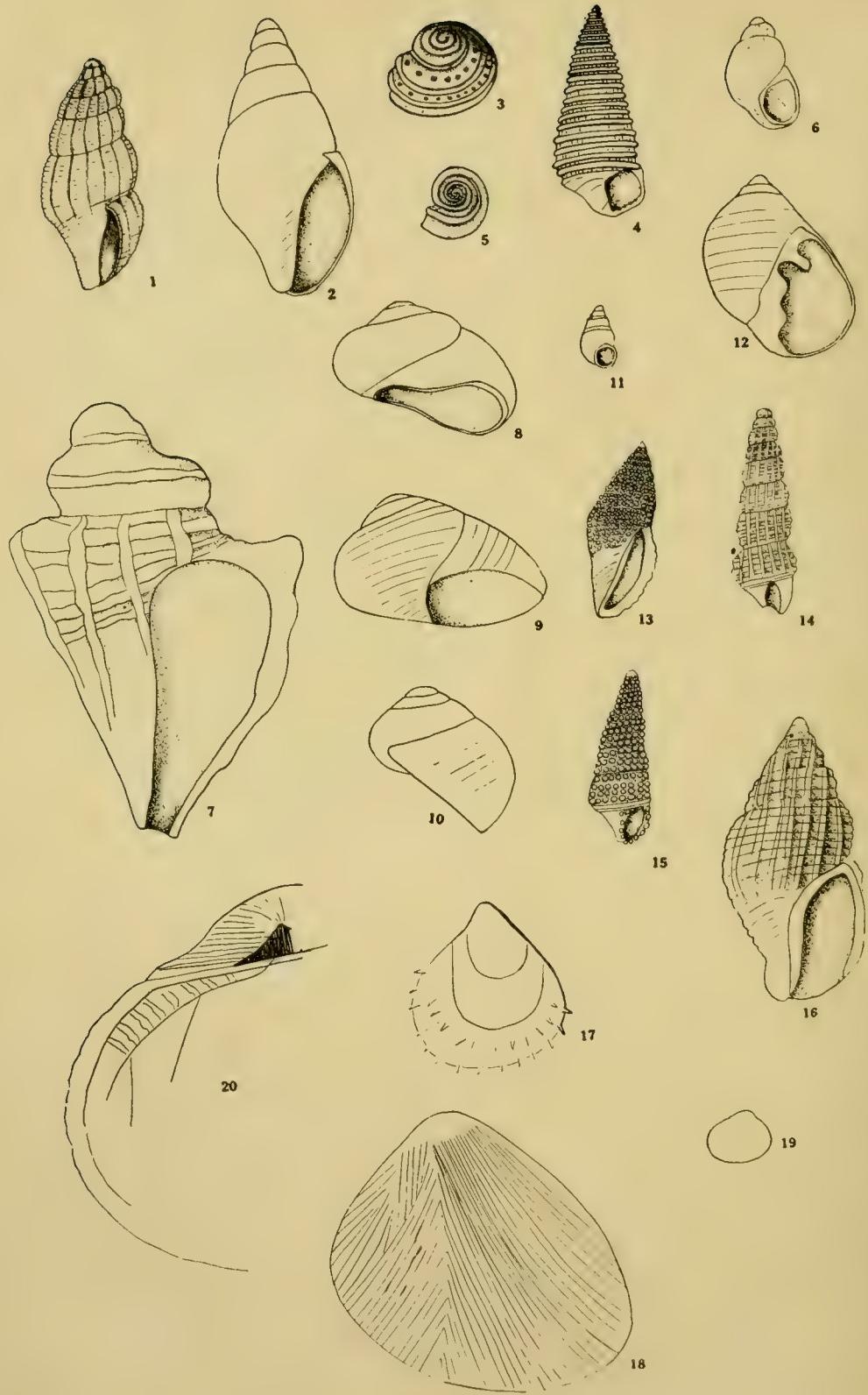


Plate V

# A Reconstruction of the Nervous System of a Nemertian Worm

WILLIAM A. HILTON

Small specimens of *Carinella cingulata* Cole were fixed in Mercuric chloride and cut in series. A general hematoxylin stain was very satisfactory for general anatomy. For a study of the finer structure other preparations will be necessary.

No attempt will be made to give a complete review of the literature relating to this group. Almost every systematic paper has something, because of the importance of the nervous system in classification and because in many cases the nervous system may be seen through the body-wall without dissection.

One of the first extensive accounts of these animals which also included quite a consideration of the nervous system was McIntosh in 1874. Several of the genus *Nemestes* were studied and the general form of the nervous system shown. *Amphipheris* is shown in a similar manner with a single lobe of the brain and with the two brain commissures. *Tetrastemma* is shown in a similar manner. Hubrecht in 1887 has an extensive paper in which the details of several nervous systems are shown as they show in reconstructions from sections. *Eupolia girardi* is especially well shown with its small dorsal and large ventral commissure and with three brain lobes. It is in this paper that Hubrecht makes his interesting comparison between the nemertians and cordates. In his paper of 1880 he has shown the structure and position of different parts of the nervous system of nemertians, especially of *Cerebratulus* of which he gives a very good figure. In this he shows a reconstruction of the brain with its chief nerves, ventral and dorsal commissures, general position of the cells, the two lobes of the brain on each side and the chief nerves. He also treats of nemertian nervous systems of many other forms, but not in so much detail.

Burger in 1890, '91, has extensive papers on the nervous system of the group. He discusses not only the general form, but also the minute structure of the nervous system of a number of different types. In 1895 Burger has another important paper on this

group of animals. In it he shows in some forms a marked dorsal ganglion and a ventral ganglion with the typical nerves. Burger showed that all ganglion cells are unipolar, without membranes. Montgomery, 1897, discusses the minute anatomy of the nerve cells. Coe, 1895 and 1910, considers the general anatomy of the nervous system, but nerve details are for the most part not shown.

In a young *Carinella cingulata* Cole which I have studied by means of reconstructions, I find no unusual features. The nervous system is typical of the group. The brain, however, is not very clearly made up of two lobes on each side. This may be because the specimen used was a young one. This may also be the reason why the brain is not sharply marked off from the lateral nerve cords.

Figure 1 shows the brain and part of the lateral cords from the ventral side. From the two halves of the brain come the nerves to forward parts. The small dorsal commissure is shown with its usual median extension. From the larger ventral commissure come the two nerves to the proboscis, lateral to these are the nerves to the intestine, while from the ridge of the lateral cords the lateral nerves are shown.

Figure 2 in the larger drawing at the right shows the nervous system as viewed from the side with the dorsal side to the left. The central core of the ganglion and cord is to indicate the position of the fiber area. The small drawings at the left show various levels of the nervous system as seen in cross section. The ventral side is up. The drawing at the top is through the brain before the commissures are reached, the next lower is through the thickest part of the brain and the lower two drawings are through one of the lateral cords.

*Burger, O.*

1891

Beiträge zur Kenntnis des Nervensystems der Wirbellosen. Neue Unter, über das Nervensystem der Nemertinen. Inst. a. d. Zool. Sta. Neah. 10.

*Burger, O.*

1890

Beiträge zur Kenntnis des Nervensystems der Nemertinen. Zeit. Wiss. Zool. Bd. L.

1895

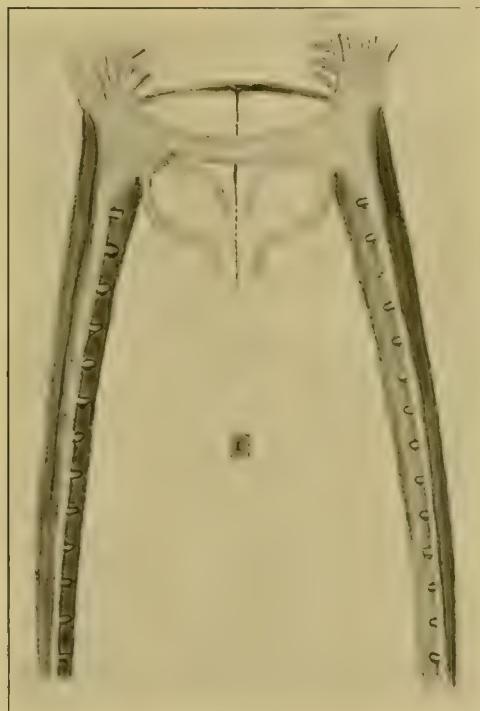
Die Nemertinen.

Fauna u. Flora d. Golfs v. Neapel.

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<i>Coe, W. R.</i>	1910
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<i>Haller, B.</i>	1889
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<i>Mosley, H. N.</i>	1875
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#### EXPLANATION OF PLATE

- Figure 1. Reconstruction of the nervous system of *Carinella* shown from the ventral side. Explanation in text. X75.
- Figure 2. Figure at the left side view of a reconstruction of the upper portion of the central nervous system of *Carinella*.  
The figures at the right are from cross sections taken at various levels.  
The upper and the two lower figures are from one side only. Further explanations in the text. X75.





# A Tentative List of Moths From the Claremont-Laguna Region

For the past four or more years moths have been collected by a number of students both in Claremont and at Laguna. The college collection previous to this time was brought together by Charles Metz and many of the moths were determined by Smith. The more recent collections are by P. A. Lichti, R. Shallenberger, and a few others. Most of the recent determinations are by Barnes and McDonough and by Busck. In many of the specimens great difficulty was encountered in making out the labels made by many different people and so far as possible Dyar's list was used as a check on these names. The drawings were made by Miss Charlotte Johnson, the photographs by L. O. Cooper. In some cases drawings seemed better than photographs, but there is no good substitute for a specimen. All are natural size or very slightly reduced.

## SPINGIDÆ

*Protoparce carolina* Linn. Det. B., McD. Lichti, collector. Claremont and Laguna Beach, Cal. Yellow spots on abdomen. Fig. 1.

*Pholus achemon* Drury. Lichti, collector. Claremont, Cal. Fig. 2.

*Celerio lineata* Fab. Claremont-Laguna. Fig. 3.

*Hyloicus drupiferarum* A. and S. Claremont. Fig. 4.

*Pachysphinx modesta* Har. Det. by B. and McD. Lichti, collector. Claremont, Cal. Pink hind wings. Fig. 5.

*Hæmmorhagia thetis* Bdv. B. and McD. Lichti and students. Claremont, Cal. Fig. 6.

## SATURNIIDÆ

*Samia rubra* Behr. B. and McD. Lichti and students. Mountains, Claremont and Laguna Beach. Fig. 7.

*Pseudohazis eglanterina nuttalli* Streck. Shallenburger. Bray. collector. Mt. San Antonio, 10,000 feet. Fig. 8, male; Fig. 9, female.

## SYNTOMIDÆ

*Ctenucha multifaria* Wlk. B. and McD. Lichti. Laguna Beach.  
Fig. 10.

## LITHOSIIDÆ

*Diacrisia vagans* Bdv. B. and McD. Lichti. Laguna Beach.  
Fig. 11.

*Illice libermacula* Dyar. B. and McD. Lichti. Laguna Beach.  
Fig. 12.

*Crambidia suffusa* Dyar (?). B. and McD. Lichti. Laguna Beach. Fig. 13.

## ARCTEIDÆ

*Apantesis autholea* Boisd. B. and McD. Lichti. Claremont.  
Body red, tip of abdomen black. Fig. 14.

*Ectypia clio* Pack. B. and McD. Lichti. Laguna Beach. Fig. 15.

*Archnis picta* Pack. B. and McD. Lichti. Laguna Beach. Fig. 16.

*Leptarctia californica decia* Bdv. Peck. Claremont. Orange  
hind wing. Fig. 17.

## NOCTUIDÆ

*Autographa biloba* Step. B. and McD. Lichti. Laguna Beach.  
Fig. 18.

*A. californica* Spey. B. and McD. Lichti. Laguna Beach.  
Fig. 19.

*A. brassicea* Riley. B. and McD. Lichti. Laguna Beach. Fig. 20.

*Bryophila viridata* Sm. Sm. Metz. Claremont. Fig. 21.

*Admetovis similis* Barnes. J. B. S. Metz. Claremont. Fig. 22.

*Caradrina extimia* Walk. J. B. S. Metz. Claremont. Fig. 23.

*Copicucullia incresa* J. B. S., J. B. S. Metz. Claremont. Fig. 24.

*Copablepharon sanctæ-inonicæ* Dyor. B. and McB. Lichti. La-  
guna Beach. Fig. 25.

*Cirrhobolina mexicana* Behr. B. and McD. Lichti. Laguna  
Beach. Fig. 26.

*Cænurgia adversa* Grt. J. B. S. Metz. Claremont. Fig. 27.

*Copibryophia angelica* Grey. J. B. S., J. B. S. Metz. Clare-  
mont. Fig. 28.

- Catocala osculata* Hulst. Hulst. and Shallenberger. Shal. Mountains near Claremont, 5,000 feet. Male. Fig. 29.
- Euclidia cuspidea* Hbr. J. B. S. Metz. Claremont. Fig. 30.
- Feltia annexa* Tr. B. and McD. Lichti. Laguna Beach.
- Galgula partita* Gue. J. B. S. Metz. Claremont. Fig. 31.
- Hadena cuculliformis* Grote. J. B. S. Metz. Claremont. Fig. 32.
- Heliophila unipuncta* Haw. J. B. S. Metz. Claremont. Fig. 33.
- Agrotis ypsilon* Rot. B. and McD. Lichti. Claremont. Fig. 34.
- Heliothis obsoleta* Fabr. B. and McD. Houghton. Rivera, Cal. Fig. 35.
- H. phlogophagus* G. and R. B. and McB. Lichti. Laguna Beach. Fig. 36.
- Heliophila imperfecta* J. B. S. B. and McD. Lichti. Laguna Beach. Fig. 37.
- Inceta aurantica* Hy.-Edw. B. and McD. Lichti. Laguna Beach. Fig. 38.
- Litocala sensignata* Harvey. B. and McD. Lichti. Laguna. Fig. 39.
- Morrisonia mucens* Hub. J. B. S. Metz. Claremont. Fig. 40.
- Mamestra 4-lineata* Mor. J. B. S. Metz. Claremont. Fig. 41.
- M. cuneata* Gröte. J. B. S. Metz. Claremont. Fig. 42.
- Neuria proclivata* Grt. (?). B. and McD. Lichti. Laguna Beach. Fig. 43.
- Noctua rivolosa* (?) J. B. S., J. B. S. Metz. Claremont. Fig. 44.
- N. havilæ* J. B. S., J. B. S. Metz. Claremont. Fig. 45.
- Nauangana prolivalis* Buly (?). B. and McD. Lichti. Laguna Beach. Fig. 46.
- Oncocnemis behrensis* J. B. S., J. B. S. Metz. Claremont. Fig. 47.
- Mamestra montara* J. B. S. J. B. S. Metz. Claremont. Fig. 48.
- Laphygma obscura* Riley. B. and McD. Lichti. Laguna Beach. Fig. 49.
- L. flavemaculata* J. B. S., J. B. S. Metz. Claremont. Fig. 50.
- Lepipolys perscripta* Gue. B. and McD. Lichti. Laguna. Fig. 51.

- Peridroma saucia* J B S., J. B. S. Metz. Claremont. Fig. 52.
- Pleonectyptera finitima* J. B. S., J. B. S. Metz. Claremont. Fig. 53.
- Polia namestra montana* J. B. S., J. B. S. Metz. Claremont. Fig. 54.
- Polia namestra quadrilineata* J. B. S., J. B. S. Metz. Claremont. Fig. 55.
- Polia aefkeni* Grt. J. B. S., J. B. S. Metz. Claremont. Fig. 56.
- Polia iclaudabilis* Grt. B. and McD. Lichti. Laguna.
- Trachea susquesa* Grt. B. and McD. Lichti. Laguna. Fig. 57.
- T. fumosa* Grt. (near). B. and McD. Lichti. Laguna.
- Trichoclea antica* J. B. S., B. and McD. Metz. Laguna. Fig. 58.
- T. edwardsii* J. B. S., J. B. S. Metz. Claremont. Fig. 59.
- Syneda ochracea* Behr. B. and McD. Laguna. Lichti. Fig. 60.
- S. howlandi* Grote. B. and McD. Lichti. Laguna. Fig. 61.
- Scotogramma chartaria* Grote. B. and McD. Lichti. Laguna Beach. Fig. 62.
- S. shetchii* Edw. J. B. S. Metz. Claremont.
- Rancora senatocornis* List. B. and McD. Lichti Laguna. Fig. 64.
- Tetanolita greta* J. B. S., J. B. S. Lichti. Laguna Beach.
- Zosteropoda histipes* Grote. J. B. S. Metz. Claremont.
- Xylomiges curidlis* Grote. J. B. S. Metz. Claremont. Fig. 65.
- X. perlubens* Grote. J. B. S. Metz. Claremont. Fig. 66.
- Zela (Homoptera) salicis* Behr. Lichti Laguna. Fig. 67.
- Laphygma frugiperda* S. and A. B. and McD. Lichti. Laguna.

### NOTODONTIDÆ

- Cerura scolopendria* Bdv. B. and McD. Lichti. Laguna. Fig. 68.
- C. cineria* var. *unceroides* Dyar. B. and McD. Lichti. Laguna. Fig. 69.

### LIPARIDÆ

- Hemerocampa vellusta* Bdv. B. and McD. Lichti. Claremont. Fig. 70.

## LASIOCAMPIDÆ

*Epicnaptera americana ferruginea* Pack. B. and McD. Lichti. Laguna Beach. Red-brown color. Fig. 71.

*Gloveria garamella* Stre. B. and McD. Lichti. Laguna Beach. Fig. 72.

## DIOPTIDÆ

*Phryganidia californica* Pack. Shallenberger. Shallenberger. Claremont. Fig. 73.

## GEOMETRIDÆ

*Cymatophora (Itame) guenearia* Pack. B. and McD. Lichti. Claremont. Fig. 74.

*Cosymbia serrulata* Pack. B. and McD. Lichti. Claremont. Fig. 75.

*Diastictis fracturalis* Zell. B. and McD. Lichti. Claremont. Fig. 77.

*Euphia implicata* Gn. B. and McD. Lichti. Laguna. Fig. 78.

*Eois lanceolata* Hest. B. and McD. Lichti. Laguna. Light colored. Fig. 75.

*Eois granitaria* Pack. B. and McD. Lichti. Claremont. Darker than the above. Fig. 76.

*Glaucina golgolota* Hulst. Metz. Claremont. Fig. 79.

*G. epiphysaria* Dyor. B. and McD. Lichti. Laguna.

*Merochlora fascularia* Gr. B. and McD. Lichti. Laguna. Pale green front wing. Fig. 80.

*Marmarea occidentalis* Hulst. Dyar. Metz. Claremont. Fig. 81.

*Neoterpes edwardsata* Pack. Dyar. Metz. Claremont. Fig. 82.

*Perizoma custodeata* Guen. Dyar. Metz. Claremont. Fig. 83.

*Plataea californiaria* H. S. Dyar. Metz. Claremont. Fig. 84.

*P. lessaria* Pears. B. and McD. Lichti. Laguna. Fig. 85.

*Pherne subpunctata* Hlt. Dyar. Metz. Claremont. Fig. 86.

*Prausta mustelinalis* Pack. B. and McD. Lichti. Laguna.

*Racheospila glaucomarginaria* Barnes Ms. Lichti. Laguna. Fig. 87.

- Sabulodea nudilata* Pack. Dyar. Metz. Claremont. Fig. 88.  
*Sciagraphia excurrata* Pack. B. and McD. Lichti. Laguna. Fig. 89.  
*S. californiaria* Pack. B. and McD. Lichti. Laguna. Fig. 90.  
*Stammodes cœnonymphata* Hulst. Dyar. Lichti. Laguna. Fig. 91.  
*Selidosema geminata* Hulst. Ms. Dyar. Metz. Claremont. Fig. 92.  
*Neoterpes edwardsata* Pack. Metz. Claremont. Fig. 93.  
*Stenaspilates apapinaria* Dyar. Claremont. Fig. 94.  
*Zenophleps lignicolorata* Pack. Claremont. Fig. 95.  
*Colymbia serrulata* Pack. B. and McD. Lichti. Laguna.  
*Ceratodalia excurrata* Grt. B. and McD. Lichti. Laguna.  
*Merochlora faseolaria* Gue. B. and McD. Lichti. Laguna.  
*Tornos fieldi* Gross. B. and McD. Lichti. Laguna.  
*Sabulodes caberata* Given. Dyar. Lichti. Laguna.  
*S. nudilata* Dyor (?) Lichti. Laguna.  
*Macaria dieldi* Swett. Lichti. Laguna.

#### FAMILY PYRALIDÆ

- Yuma trabalis* Grote. B. and McD. Lichti. Laguna. Fig. 96.  
*Dicymolomia metalliferales* Pack. B. and McD. Lichti. Laguna. Fig. 97.  
*Glaphyria reluctantis* Hulst. B. and McD. Lichti. Laguna. Fig. 98.  
*Hulstia undulatella* Clem. B. and McD. Lichti. Laguna. Fig. 99.  
*Homæosoma mucidellum* Ray. (Probably.) B. and McD. Lichti. Laguna. Fig. 100.  
*Pyralis farinalis* L. B. and McD. Lichti. Laguna. Fig. 101.  
*Lipocosma (?) albubamus* Br. B. and McD. Lichti. Laguna. Fig. 102.  
*Sarata umbrella* Dyor. B. and McD. Lichti. Laguna. Fig. 103.  
*Nomophila noctuella* D. and S. B. and McD. Lichti. Laguna. Fig. 104.

*Ommatopteryx ocellae* Haw. B. and McD. Lichti. Laguna.  
Fig. 105.

- Ephesiodes nigrella* Hlst. B. and McD. Lichti. Laguna.  
*Diatrae prosenes* Dyar. B. and McD. Lichti. Laguna.  
*Pyrausta xanthocrypta* Dyar. B. and McD. Lichti. Laguna.  
*Glaphyria reluctantis* Hulst. B. and McD. Lichti. Laguna.  
*Lipographis fenestrella* Pack. B. and McD. Lichti. Laguna.  
*Phlyctenia profundalis* Pack. B. and McD. Lichti. Laguna.  
*Sarata umbrella* Dyar. B. and McD. Lichti. Laguna.

### TORTRICIDÆ

- Tortrix peritana* Clem. Bus. Lichti Laguna.  
*T. citrana* Fer. B. and McD. Lichti. Laguna. Fig. 106.  
*Eucosma* sp. Lichti. Laguna.

### TINEIDÆ

- Acrolophus flavigornis* Bus. Busch. Lichti. Laguna.

### GELECHIIDÆ

- Gelechia* sp. *Recurvaria* sp. Bus. Lichti. Laguna.  
*Phthorimæa operculata* Zeller. Busck. Lichti. Laguna.

### ELACHISTIDÆ

- Morpha* sp. B. Lichti. Laguna.

### YPONOMEUTIDÆ

- Plutella maculipennis* Curt. Busck. Lichti. Laguna.

List of somewhat doubtful or imperfect determinations. All collected at Laguna Beach by P. A. Lichti:

- Eois demissaria* Hub., Fig. 107. *Tardchedia caudifacta* Hbn., Fig. 108. *Pleonectiptera subflavidalis* Grote, Fig. 109. *Givia marga* B. and McD., Fig. 110. *Samcodes subcostalis* Hmp., Fig. 111. *Eusoa sptentrionalis* Wlk., Fig. 112. *Lycophora marginata* Hw., Fig. 113. *Hemella infidelis* Dyar, Fig. 114. *Cænurgia adversa* Grt. *Tarache coquilletti* J. B. S. *Eublemma minina* Gro. *Pyramata xanthocrypta* Dyar (?). *Cirphis farcta* Smith. *Eriophyga inorta* Smith. *Dpantesis antholea* Bdv. *Proximes mindara* B. and McD. *Valdinia mirabilicornella* Dyar.

(Contribution from the Zoological Laboratory of Pomona College)



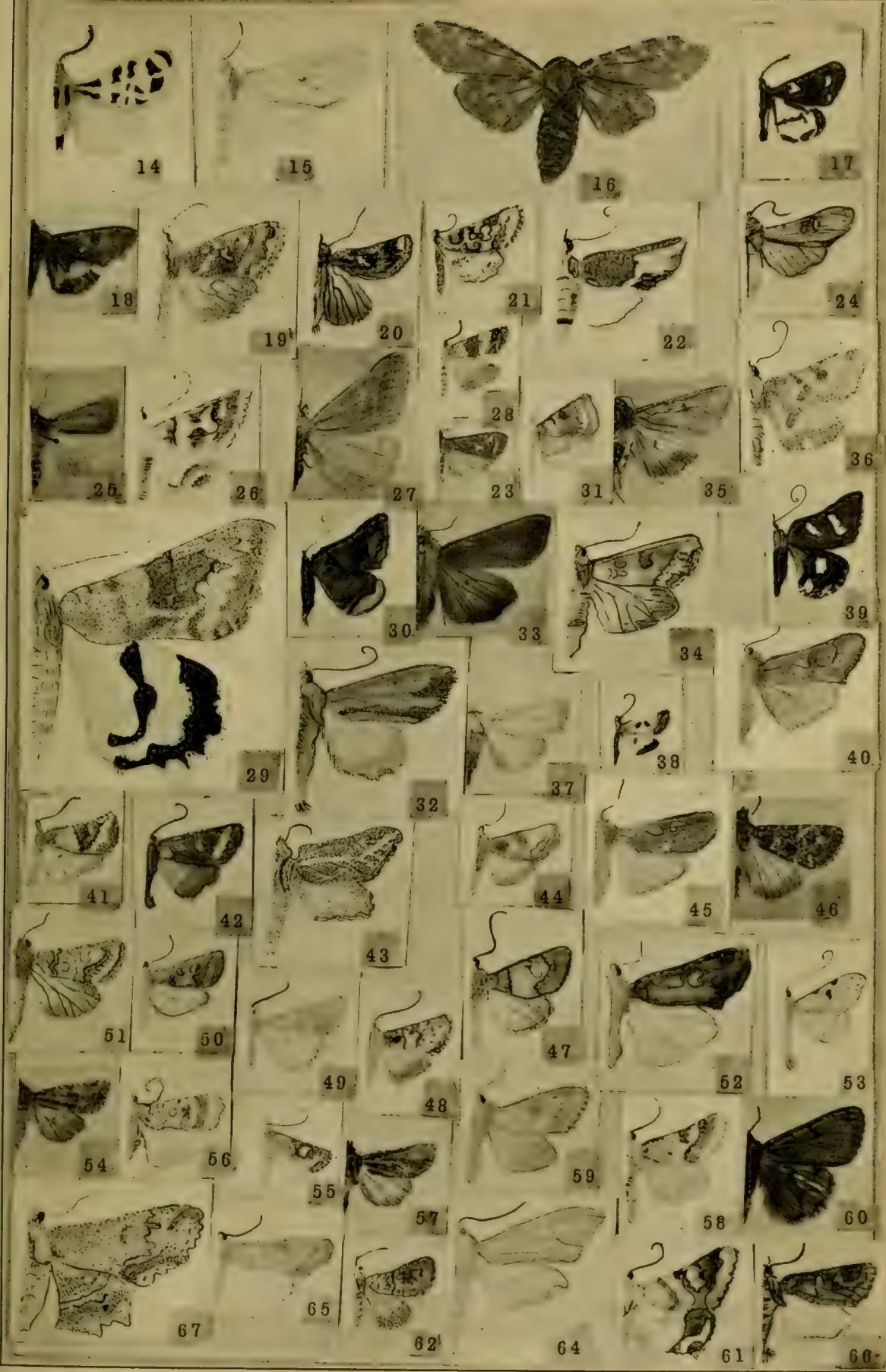
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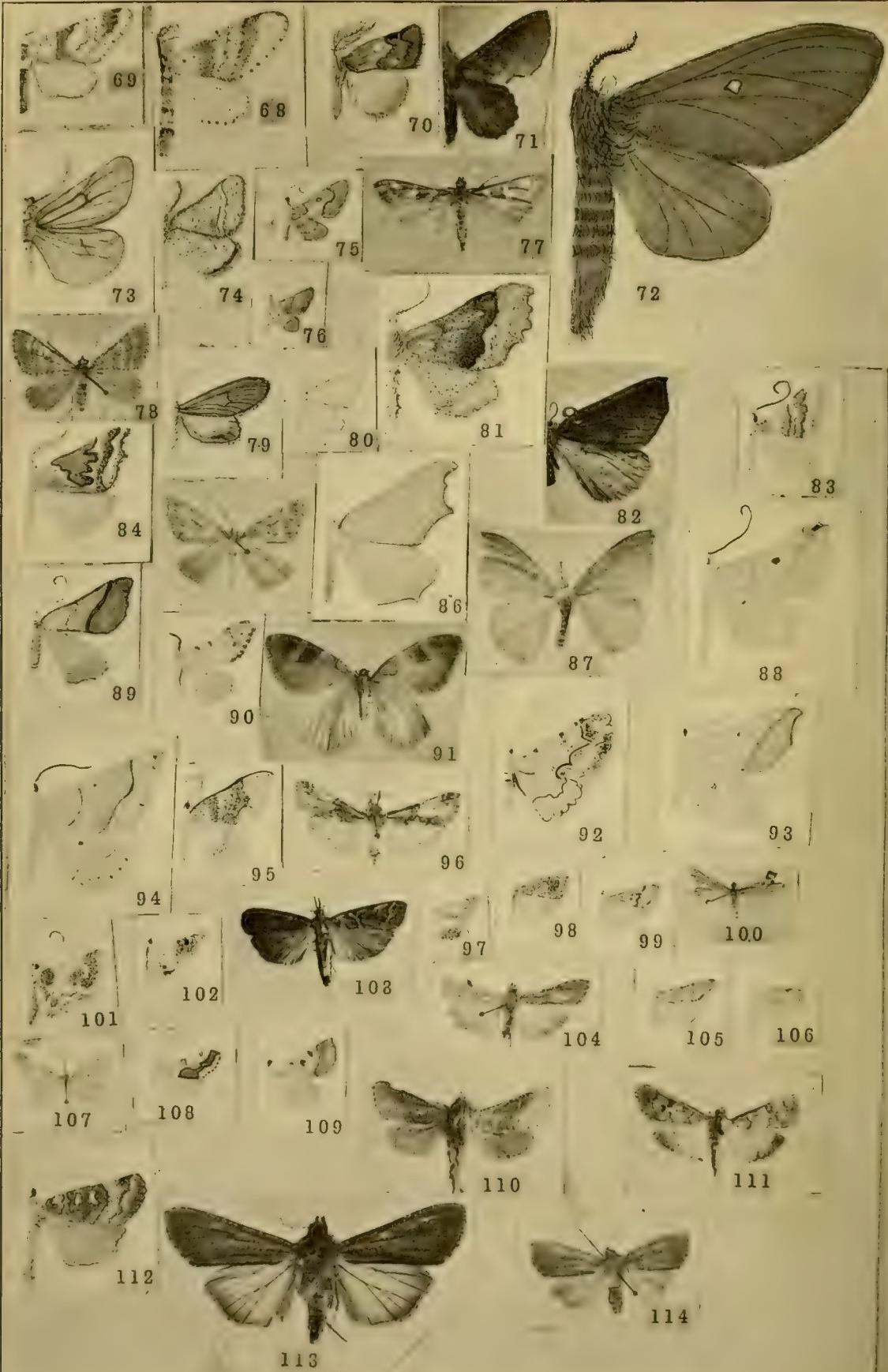


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# Preliminary List of Butterflies From the Claremont-Laguna Region

The specimens were chiefly collected in and about Claremont by students in the past three or four years. Most of the drawings were from specimens collected by Peck. The drawings are by Miss Lucy Smith, the three photographs by L. Cooper. We have F. Grinnell to thank for suggestions as to identity and names in many cases. All are natural size.

## NYMPHALIDÆ

- Anosia berenice* Bates. Male. Fig. 1.  
*Anosia plexippus* Linn. Male. Fig. 2.  
*Argynnis callippe* Boisd. Male. Fig. 3.  
*A. semiramis* Edw. Female. Fig. 9.  
*Melitaea chalcedon* Doub.-Hew. Male. Fig. 5.  
*M. gabbi* Behr. Male. Fig. 6.  
*M. wrighti* Edw. Male. Fig. 7.  
*Phyciodes mylitta* Edw. Female. Fig. 10.  
*Junonia cænia* Hub. Male. Fig. 11.  
*Grapta satyrus* Edw. (?). Male. Fig. 12.  
*Vanessa californica* Boisd. Fig. 13.  
*V. antiopa* Linn. Male. Fig. 14.  
*Pyrameis atlanta* Linn. Male. Fig. 15.  
*P. huntera* Fabr. Male. Fig. 8.  
*P. cardui* Linn. Male. Fig. 16.  
*P. caryæ* Hib. Male. Fig. 17.  
*Adelpha californica* Butl. Female. Fig. 18.  
*Limenitis lorquini* Boisd. Male. Fig. 19.  
*Satyrus charon* Edw. (?). Female. Fig. 20.  
*S. sylvestris* Edw. (?). Fig. 25.  
*Cænomorpha ceres* Butl. Female. Fig. 22. White.  
*C. galactinus* Boisd. White.  
*C. californica* Doub.-Hew. Brownish white.

## LEMONIIDÆ

*Calephelis nemesis* Edw. Male. Fig. 23. Many fine lines on brown wings.

*Lemonias vergulti* Behr.

## LYCAENIDÆ

*Chrysophanus helloides* Boisd. Male. Fig. 21. Red-brown. Red near tip of hind wing.

*Chrysophanus gorgon* Boisd. Female. Fig. 26.

*C. aorta* Boisd. Female. Fig. 27. Brown.

*Thecla halesus* Cramer. Male. Fig. 28. Blue-purple. Cole. Redlands.

*T. iroides* Boisd. Female. Fig. 31. Dark brown.

*T. spinetorum* Boisd. Red-brown.

*T. saepium* Boisd. Red-brown.

*T. melinus*. Hub. Fig. 30.

*Thecla irroides* Boisd. Female. Fig. 31. Dark brown.

*Lycæna polyphemus* Boisd (?) .

*L. sonorensis* Field. Female, Fig. 34. Male, Fig. 35. Blue, red spots on wings.

*L. enoptes* Boisd. Female, Fig. 32. Male, Fig. 33. Male, blue. Female, brown.

*L. acmon*, Dbl. Hew. Male blue, female brown. Caudal spots more marked.

*L. amyntula* Boisd. (?) . Female, Fig. 37. Blue-brown.

*L. pseudargiolus piasus* Boisd. Male, Fig. 40. Blue.

*L. marina* Reak. Female, Fig. 41. Male, light brown. Female, blue-brown.

*L. exilis* Boisd. Male. Fig. 42. Blue-brown.

*L. hanno* Stoll. (?) . Fig. 36. Blue-brown.

*L. sagittigera* Field. Fig. 38. Male, blue. Female, blue-brown.

*L. heteronea* Boisd. Male, Fig. 39. Male, blue. Female, blue-brown.

## PIRIDÆ

*Euchlœ australis* Grinnell. Female, Fig. 58. White.

*E. sara reakirti* Edw. Female, Fig. 59. Wings orange tipped.

- Colias ariadne* Edw. Male, Fig. 60. Female, Fig. 61. Yellow.  
*C. keewaydin* Edw. Male, Fig. 63. Female, Fig. 64. Yellow.  
*C. harfordii* Hy. Ed. Female, Fig. 65. Male, Fig. 66.  
*C. eurytheme* Boisd. Female, Figs. 53 and 54. Male, Fig. 67.  
*Pieris protodice* Boisd.-Lec. Female, Fig. 68. Male, Fig. 69.  
White.  
*Pieris rapæ* Linn. Female, Fig. 70.  
*Meganostoma eurydice* Boisd. Male, Fig. 56. Female, Fig. 57.  
Male, orange. Female, yellow.  
*Meganostoma cæsonia* Stoll. (?). Male. Fig. 55. Yellow.

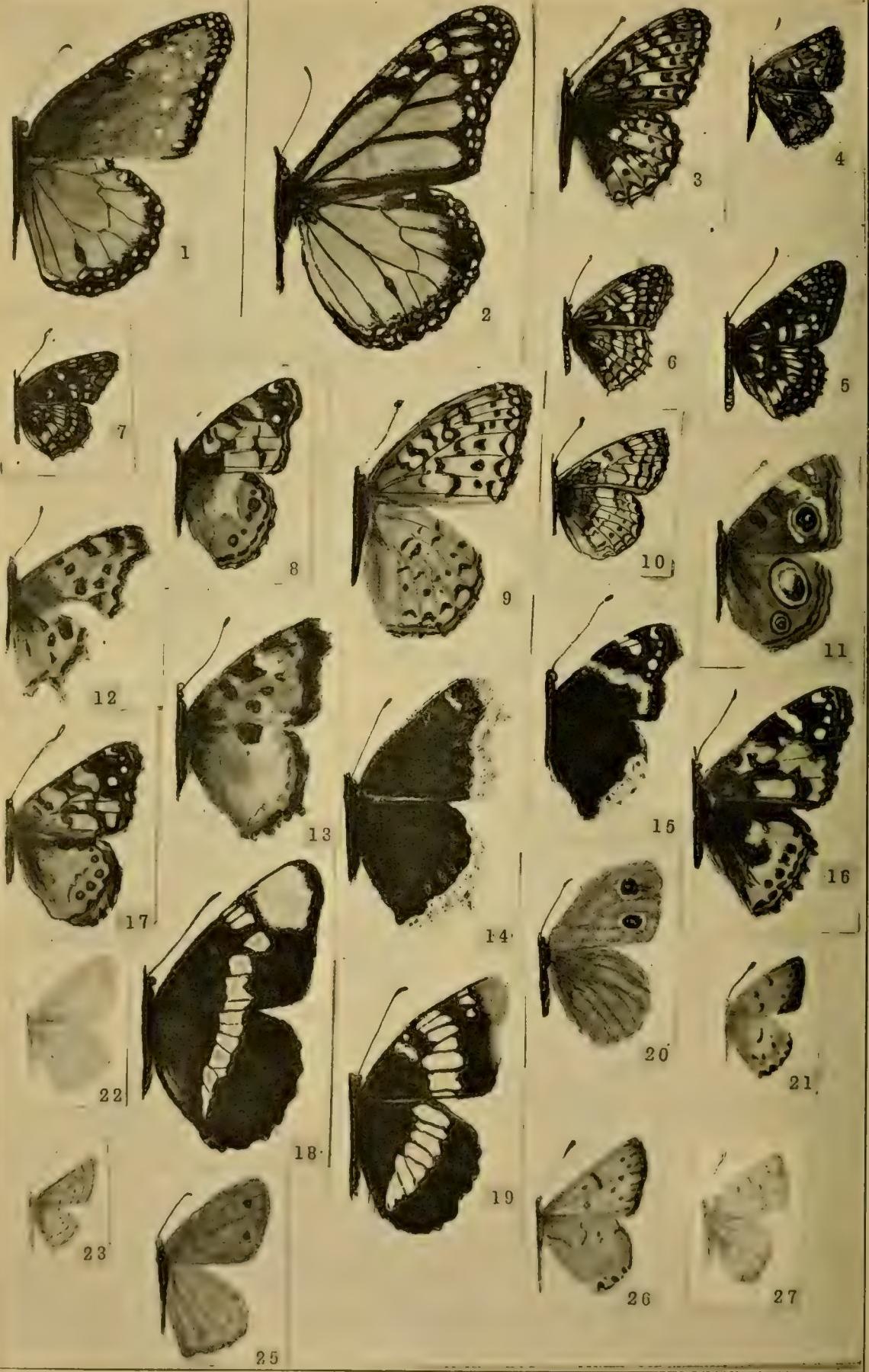
### PAPILIONIDÆ

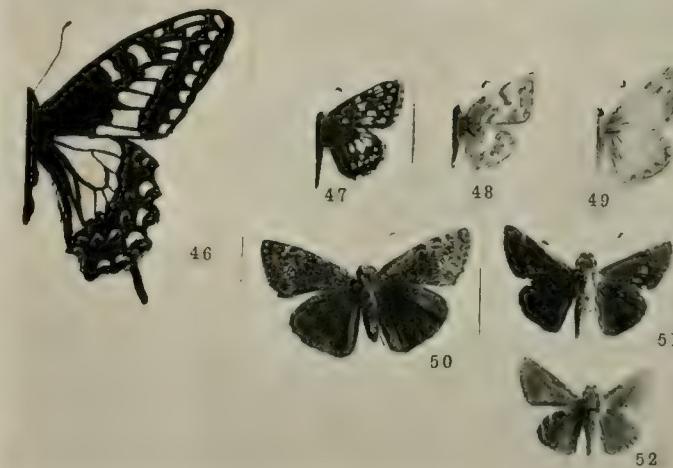
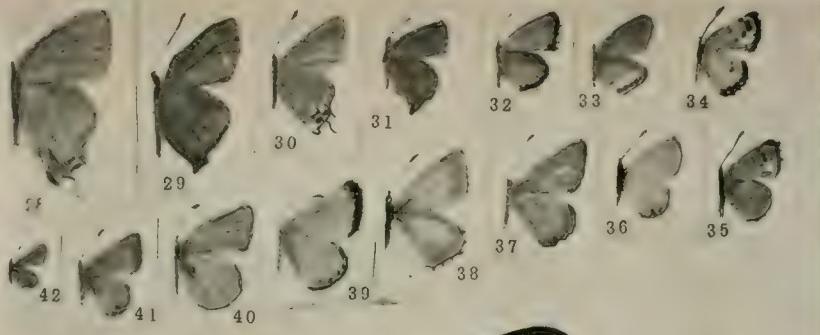
- Papilio eurymedon* Boisd. Male, Fig. 45. Light yellow and black.  
*P. rutulus* Boisd. Male, Fig. 44. Yellow and black.  
*P. zolican* Boisd. Male, Fig. 46. Yellow and black.  
*P. asterias* Cramer (?) Male, Fig. 43. Obtained from student collection. Exact place of collection not known.

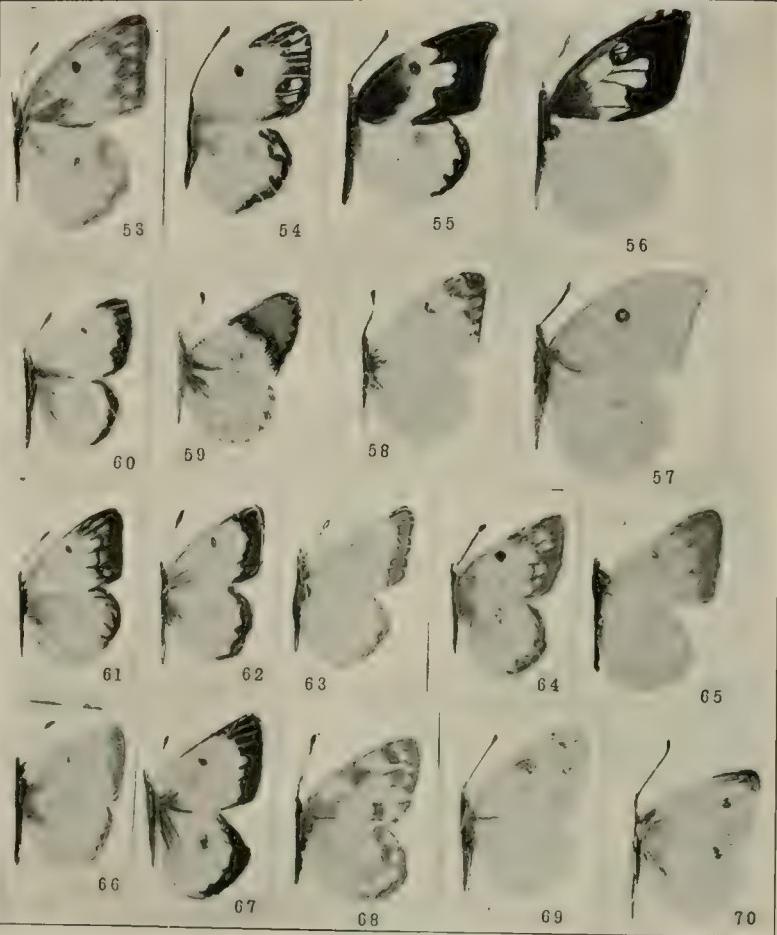
### HESPERIIDÆ

- Hesperia tessellata* Edw. Fig. 47.  
*H. montivaga* Reak. Fig. 48.  
*H. ericerorum* Boisd. Fig. 49.  
*Thanaos clitus* Edw. Fig. 50.  
*Atrytone melane* Edw. Fig. 51.  
*Hylephila phylaeus* Daury. Fig. 52. Dark red-brown.

(Contribution from the Zoological Laboratory of Pomona College)







# Suggestions From the Study of the Central Nervous Systems of Invertabrates

WILLIAM A. HILTON

For the last few years I have been studying the central nervous systems of a large number of simple animals with a number of objects in view. I wish to learn as much as possible about the mechanism of the nervous system, not alone for individual and simple forms, but in general as applied to all groups. The problems of how and where impulses are carried have been among the most interesting. The structures which serve, connect and correlate senses, movements and activities have to me been more interesting than the activities themselves. What all nerve cells with their processes have in common and what differences there are between them have been constantly in mind. The functions of various parts of the neurones and the relations that cells bear to each other are important considerations. How far the relationships of species and groups are carried into the structure of the ganglia and how far adaptations have had their influence are questions not easily answered. With invertebrates as with vertebrates the problems of functional divisions of the nervous system are subjects for investigation. Then there have been the correlations of behavior with structure, not alone in the adult, but also at various stages of development.

Perhaps the dominant thought which has been in mind so far as anatomical studies go, is the question of relationship of cells to each other, of fibers and fibrils to each other and to cells. Are neurones related to neurones in continuous and definite chains, such as are clearly indicated by many Golgi, Methylen Blue and other methods, or are the well known suggestions and conclusions of Apathy that fibrils pass from cell to cell the correct interpretations? It seems that this is a problem of great importance which has not as yet reached a satisfactory solution. Different methods give different results.

The work already done leading towards a comprehension of these problems, if not their solution, has been with many groups of animals, including a few vertebrates. My papers dealing with one or another phase of the nervous system of invertebrates have been published in a number of places. Much unpublished work includes other material, but only a beginning has been made with the investigations which will be necessary for an advanced step in this direction. Some of the work so far, is necessarily of a fragmentary nature and much of the gross anatomy particularly, merely confirms the labors of many in the past. Part of the reason for studying so many forms is to extend my own knowledge so that I may have first-hand experience with all types. Part of the reason for special study here and there is to clear up doubtful points or is directed towards some particular problems in which an animal or group of animals seems to offer special advantages in the way of suggestion or solution. Hardly a form considered in any way but that brings out some important fact, some previously unpublished suggestion. Each separate investigation then may contribute a small part in itself, but each study is directed toward the larger end of attempting to solve some of the most intricate and difficult problems of Biology. More than one line of investigation is being followed, but necessarily the groundwork of future activity must be laid upon anatomical and developmental studies. Other methods are used or are to be used as necessity dictates and such as naturally develop in connection with the attack upon the central problems.

Some of the specific questions which have been in mind from the start are as follows:

1. What is the relation which exists between cell and cell in the central nervous system? Do cells merely run in contact, or is there an organic connection between them, or are both things true?
2. What part does the nucleus play (a) in conduction and (b) in general metabolism of the cells?
3. How are the fibrils related (a) within cells and (b) outside of cells?
4. What is the fibrilar structure of (a) the cell-body and (b) of the material between cells?

5. How are cells related to each other (a) by neurites and dendrites or fibers, and (b) by fibrils?

6. How and where is the impulse carried? How are the non-medullated fibers able to carry a definite stimulus or impulse if they are not insulated?

7. Do nerve cells act in groups, each for a special purpose, or is their effect a massed one, somewhat diffuse and related to other systems? Do impulses pass along definite or diffuse pathways?

8. Does the size of the animal make a difference in the complexity of the nervous system, and is this complexity or lack of it shown in the nervous system as a whole, or in the individual cells which compose it? Do large animals have more nerve cells than small ones? Do large animals have larger nerve cells than the small creatures?

9. Are the conditions in the central nervous systems of invertebrates comparable with those of vertebrates?

10. Are the resemblances which Patton and others have seen in Limulus and other invertebrates to vertebrate structures more than chance resemblances, due to special adaptations, or modifications of the nervous system?

11. Is it possible to determine from the brain of an invertebrate the degree of intelligence or instinct from a study of the structure?

12. Is there any higher center in an invertebrate central nervous system or in certain invertebrates which shows something of a directive power in the life of the organism?

13. What are the functional divisions of the nervous systems of invertebrates?

14. Are there advantages in the study of the nervous systems of invertebrates over the study of the brain and ganglia of more complex forms?

15. What are the animals whose nervous systems are adapted for further study of various problems?

Some suggestions in the way of my *present* opinion in respect to certain of these questions are as follows:

1. In some cases it may be that simple contact is the only way cells are related, but from the study of many forms I believe that more intimate relations between cells by means of fibrillae are often

established. The fibrillae from one cell, in many cases, actually mingle with the fibrillae within another cell. Non-medullated fibers, it seems to me, probably afford means of transmission through the sides of the fibers, as well as at the ends, although in many cases the ends may be better adapted for the purpose. It may be that the branchings at the ends of the processes of nerve cells are for the purpose of furnishing a number of contacts which are better than the sides of the fiber.

2. I believe the structure of the nucleus, together with what we know of nuclear composition and structure in general, precludes it from any decided part in conduction. It seems merely a metabolic center of less importance in mature nerve cells, as evidenced by its loss of nuclear material.

3. I believe fibrils are related both within and without cells in a similar manner. That is, they run near, touch or cross to allow the passage of impulses, but do not necessarily fuse.

4. The chief fibrillar material of cell bodies and of areas between cells, I believe, is about the same and is neuro-fibrillar or conductive. A small portion of the cell-body is merely supportive and neuroglia or other cells in the general fibrous mass of a ganglion furnish varying amounts of supportive material between cells.

5. Cells are related to each other grossly very often by neurites and dendrites, but in many, if not all cases, fibrils, either in these and formed from them, or free fibrils, relate cells, not so much as individuals as in groups.

6. The impulse is carried in the fibrils. The stimulus in non-medullated fibers is not so clearly separated as in medullated. There must be some lateral escape to other cells in ways as yet not understood. Some insulation and definiteness in certain non-medullated cells is accomplished by whole bundles for a single purpose protecting the central fibers from much lateral loss. Probably also certain large clearly separated fibers because of their positions are protected from lateral loss.

7. I believe nerve cells do not act as individuals; their effect is a massed one. Many cells supplying a region or a function act in such a way that certain cells or even areas might be lost out entirely and yet the impulse be carried.

8. As a rule the size of the animal makes for a more complex nervous system. Large animals have more and larger cells than related small ones. In the same species embryonic nerve cells may be much smaller than those of the adult, and the proportionate number of cells is greater in certain embryonic stages.

9. Vertebrates and invertebrates are similar as to function of the central nervous system, but the centers are as different as are the peripheral parts.

10. The resemblances which have been found in certain arachnid and arachnid-like forms to the structures of vertebrate brains, it seems to me, are but chance resemblances, analogous, but not homologous, structures. In certain annelids the olfactory portion of the brain is enormously developed for a special adaptation in a limited group of worms. This great olfactory area might be compared to the olfactory portion of the fore-brain of vertebrates, but I think it is clear that we have an analogy merely.

The comparisons of the nervous systems of nemertine worms with those of vertebrates are interesting, but not necessarily significant of relationships.

The segmental character of the radial nervous system of brittle stars might be taken as an indication of relationship to segmented animals with about as much justification.

11. The degree of development of intelligence and instinct, I believe, may be judged to some degree by the relative size of those parts of the brain which are not directly or intimately connected with the sense organs, such as the posterior region of the brain in many segmental animals, or the region of the mushroom bodies of some arthropods and others.

12. If there is any higher psycical center in invertebrates, it seems to me that it must be in the region not dominated by any one center or sense and receiving fibers from all, a center well supplied with nerve cells. Such a center may be the posterior portion of the brain in certain segmented animals.

13. The functional divisions are not well known. In those forms where I have traced the motor and sensory fibers they were mingled in the same nerve trunks in lower regions. The suggestions of some that sensory areas in insects' ventral ganglia are ventral,

is not altogether borne out by the facts. But I believe that the primary condition of a nervous system was superficial and sensory, as development seems to show and as the study of echinoderms seems to indicate.

In the brain some functional divisions are easy to make out in segmental animals, because certain pure sensory nerves are more easily traced.

14. I believe there are certain advantages in the study of simple types of nervous systems.

15. Almost every form so far examined is worthy of re-examination in connection with the solution of general problems.

*(Contribution from the Zoological Laboratory of Pomona College)*

# Some Remarks on the Nervous Systems of Two Sea-Urchins

WILLIAM A. HILTON

The largest and smallest species of sea-urchins occurring at Laguna Beach are the materials for this study. *Lytechinus anamesus* H. L. C., a centimeter or less in diameter, were sectioned while the radial nerves from *Strongylocentrotus franciscanus* A. Ag., of fifteen times this diameter were studied.

In sections of the smaller species it was possible to trace the chief branches of the nervous system. The long radial nerves, with their side branches to the tube feet and the branches to the large spines, with the ganglion-like rings about the bases of the spines, were easily found, also the branches from the circumoral nerve ring to the intestines in the region of Aristotle's lantern. Here stands fused with epithelial cells of the intestine. The general parts of the nervous system, such as described and figured by Delage and Heroward, '03, were found. The radial and circumoral bands of nervous tissue as is well known, resemble those of the superficial radial and circumoral strand of starfish very closely, but the deep system is poorly represented. The superficial plexus was clearly seen as a whole, only parts were made out such as ganglion-like rings at the bases of the larger spines, a section of one of which is shown in Fig. 4. From the radial nerves lateral branches were easily followed to the tube feet. Fig. 2 is a cross-section of a radial nerve, in which a branch on the right is shown just as it enters a tube foot. The radial nerves are thickest in the more central portions, thinner at the oral and especially at the aboral end. A longitudinal section of one of the radial nerves of the smaller sea-urchin is shown in Fig. 1. The oral end is below and at the left, the aboral above at the right. Fig. 2 is a cross-section of two-thirds of one of the radial nerves near its central portion, and Fig. 3 is a cross-section of a portion of a radial nerve near one end. These figures are from the smaller sea-urchin, but enlarged more than Fig. 1.

The structure of the nerve bands seems a little more complex than those of starfish, in that the nerve cells are more modified and

the fibers and fibrils more intimately related in all parts of the thickness of the nerve strands. In cross section the fibers and fibrils may be followed straight in more easily than in longitudinal sections, where there is evident a decided longitudinal disposition of the fibers and fibrils. Cells, especially in the smaller sea-urchin, are very numerous and the fibers or fibrils very small.

In the larger species the radial nerve is broad, but the cell area is narrow, with only several layers of cells. Fig. 5 is a section of one of the nerve strands from the smaller species. Fig. 6 is from the larger species. Both figures are drawn to the same scale and enlarged more than the other drawings. As the cells are larger in the larger species the fibers seem to show better. There are many fine fibrils and possibly in some cases fibers made up of fibrils. Many cells in the larger species seem more complex than bi-polar forms and some true nerve cells have migrated to the area of fibers and fibrils. Some of these show fibrillae joining the cytoplasm. Some of the cells in the fibrous area especially seem to be neuroglia cells, or at least are not nerve cells. Some multi-polar cells are shown in the figure, probably many others are multi-polar in the general cell area. There are many cross lines of fibers and fibrils in the whole thickness, but the massing of fine strands is more intricate than in starfish.

As to the general character of the nervous systems of these two species of sea-urchins is compared with starfish, they differ as much from each other in general appearance of the sections as they differ from starfish.

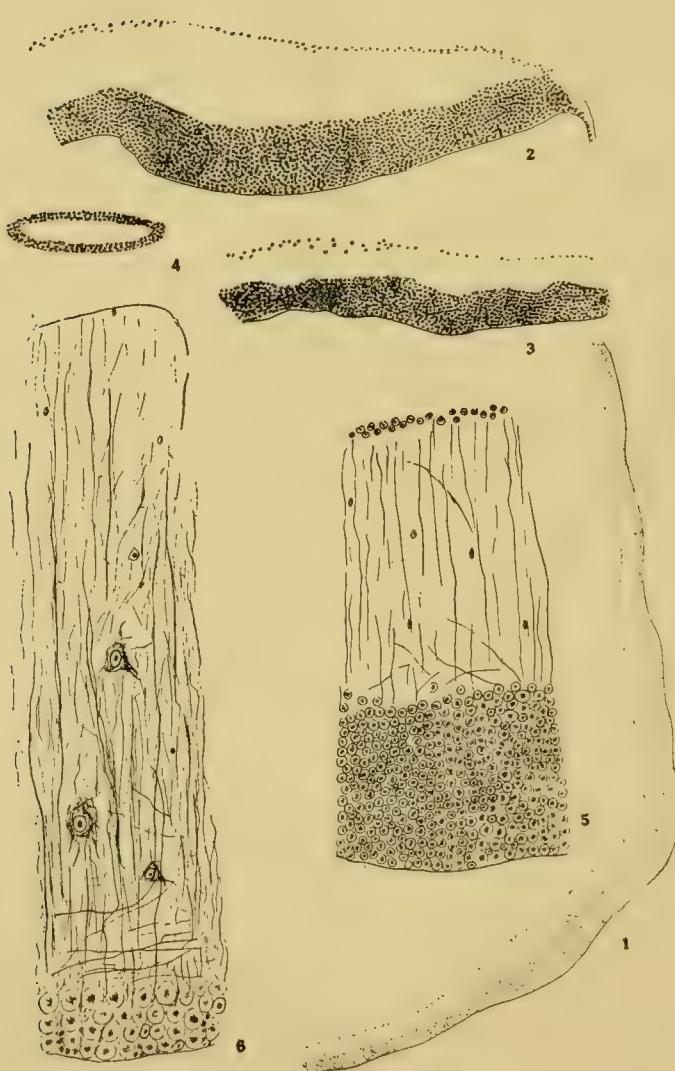
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(Contribution from the Zoological Laboratory of Pomona College)

## EXPLANATION OF FIGURES

- Figure 1. Longitudinal section through a radial nerve of *Lytechinus anamesus* H. L. C. The aboral end is toward the top of the page.  $\times 75$ .
- Figure 2. Cross section through a large part of a radial nerve of *Lytechinus*. A branch to a tube foot is shown at the right.  $\times 160$ .
- Figure 3. Cross section of a radial nerve of *Lytechinus* nearer one end than Fig. 2.  $\times 160$ .
- Figure 4. Cross section through the band of nervous tissue found at the base of one of the larger spines of *Lytechinus*.  $\times 160$ .
- Figure 5. Section through a radial nerve of *Lytechinus*, drawn with best oil objective obtainable.  $\times 750$ .
- Figure 6. Section through a radial nerve of *Strongylocentrotus franciscanus* A. Ag. Drawn the same as Figure 5.  $\times 750$ .



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# Journal of Entomology and Zoology

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## Journal of Entomology and Zoology

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William A. Hilton, Editor

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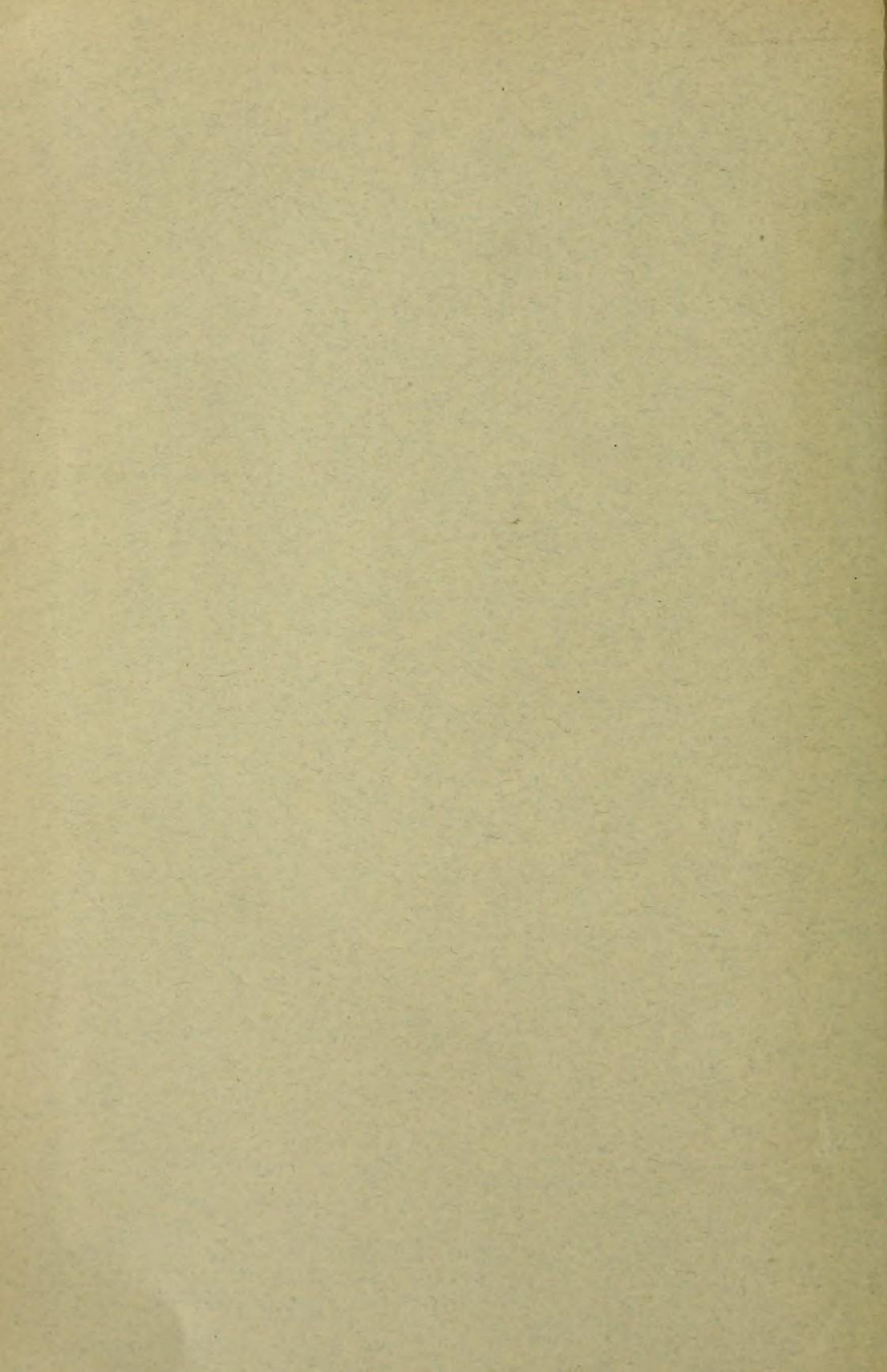
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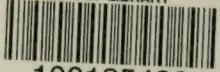
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